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Jang et al.

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(54) **DISPLAY APPARATUS**

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Related U.S. Application Data

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Jan. 19, 2023 (KR) 10-2023-0008331

(51) **Int. Cl.**
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G09G 3/36 (2006.01)

(52) **U.S. Cl.**
CPC .. ***G02F 1/133603*** (2013.01); ***G02F 1/133611*** (2013.01); ***G09G 3/3677*** (2013.01); ***G09G 3/3688*** (2013.01); *G09G 2320/0233* (2013.01)

(58) **Field of Classification Search**
CPC G02F 1/133603; G02F 1/133611; G09G 3/3677; G09G 3/3688; G09G 2320/0233
(Continued)

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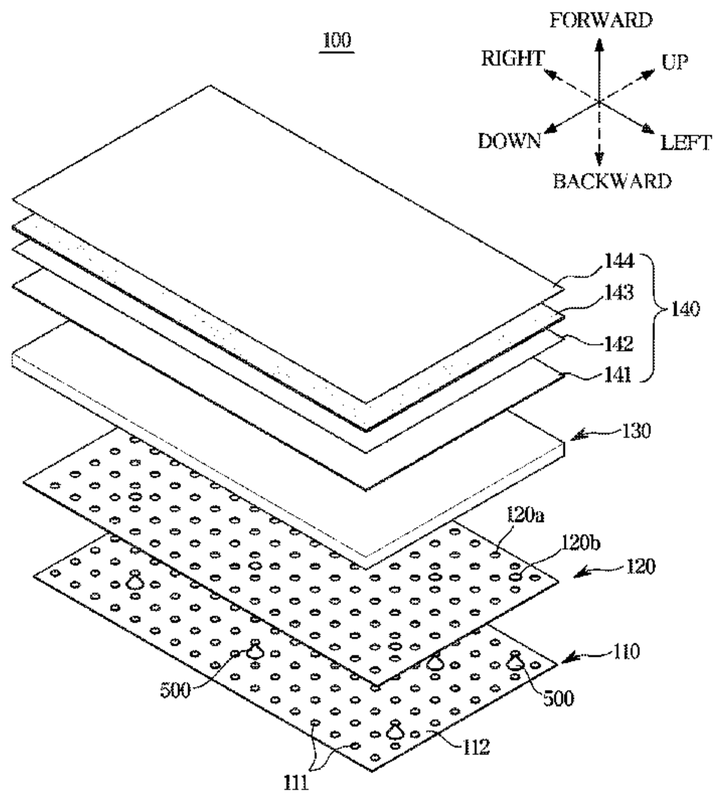
(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**

A display apparatus includes: a display panel; and a light source device configured to provide light to the display panel, wherein the light source device may include: an optical member; a substrate including a first side facing the display panel and the optical member; a light source provided on the first side of the substrate; a driving element provided on the first side of the substrate and configured to drive the light source; a plurality of lines provided on the first side of the substrate, the plurality of lines including a first line and a second line that is connected to the driving element; and a jumper supporter provided on the first side of the substrate in an area where the first line intersects the second line, the jumper supporter being configured to support the optical member, to electrically connect the first line, and to guide the second line to be spaced apart from the first line.

20 Claims, 22 Drawing Sheets



(58) **Field of Classification Search**
USPC 349/58–68
See application file for complete search history.

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FIG. 1

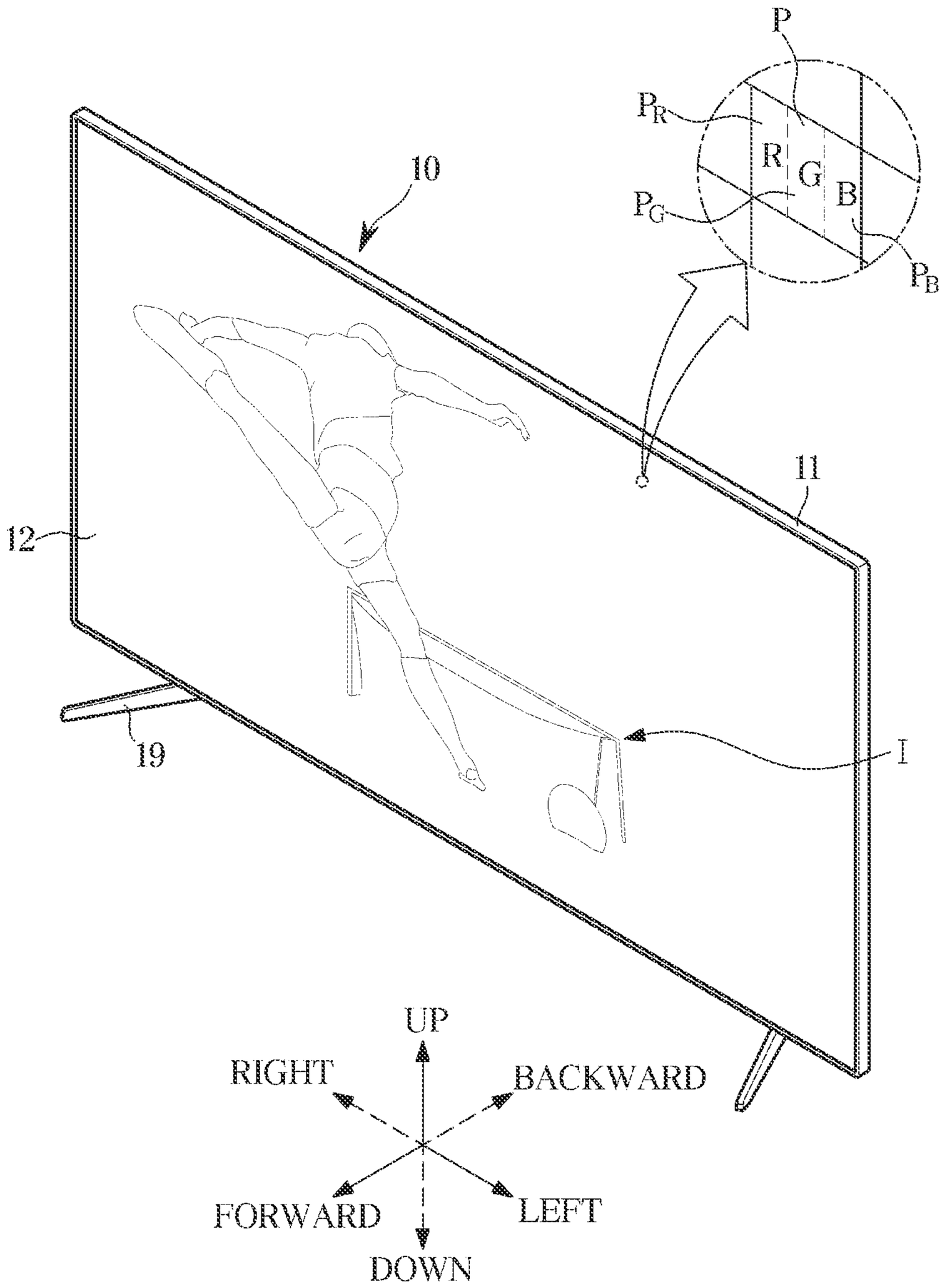


FIG. 2

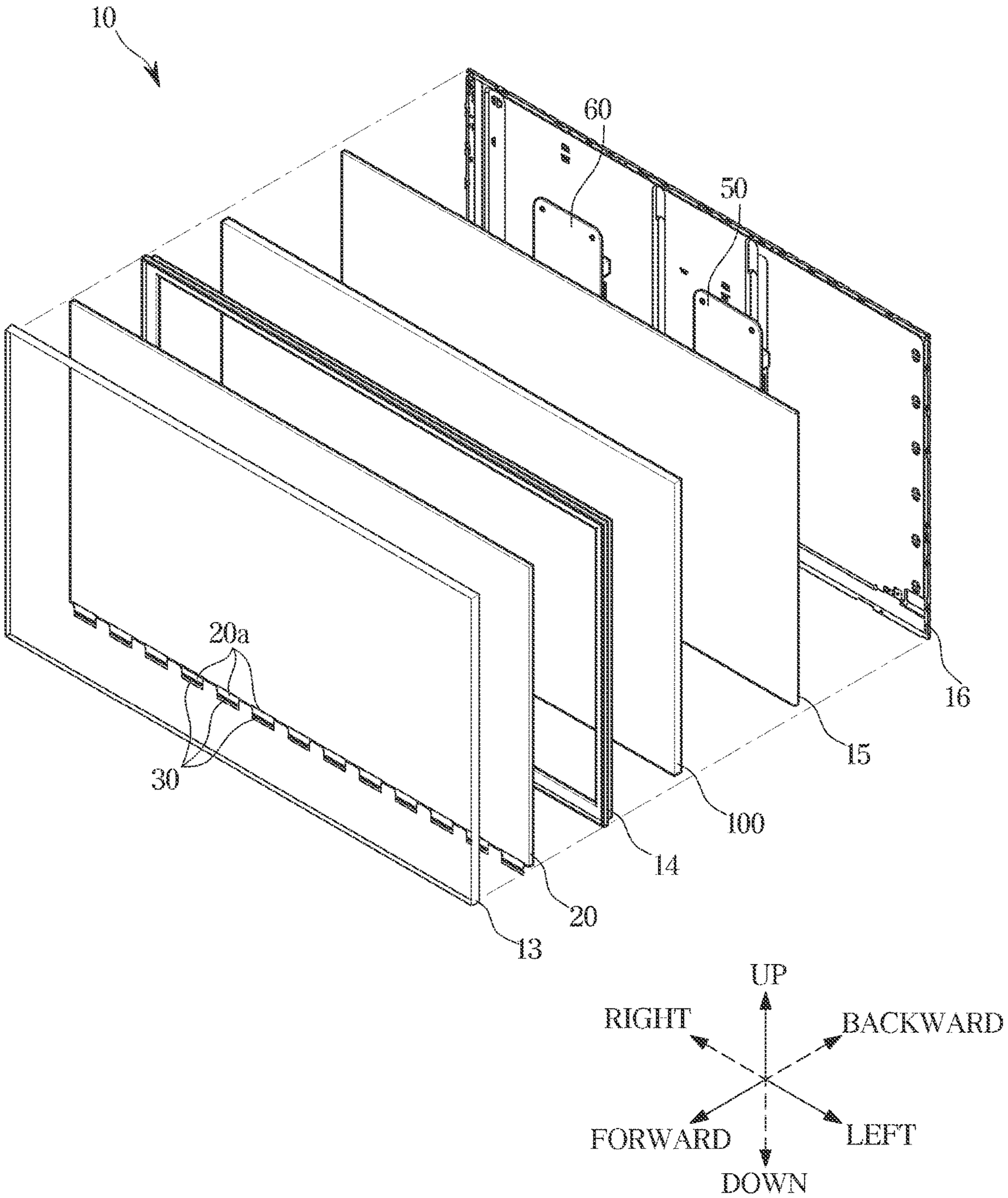

10
60
50
20a
30
16
15
100
14
20
13
UP
RIGHT
BACKWARD
FORWARD
LEFT
DOWN

FIG. 3

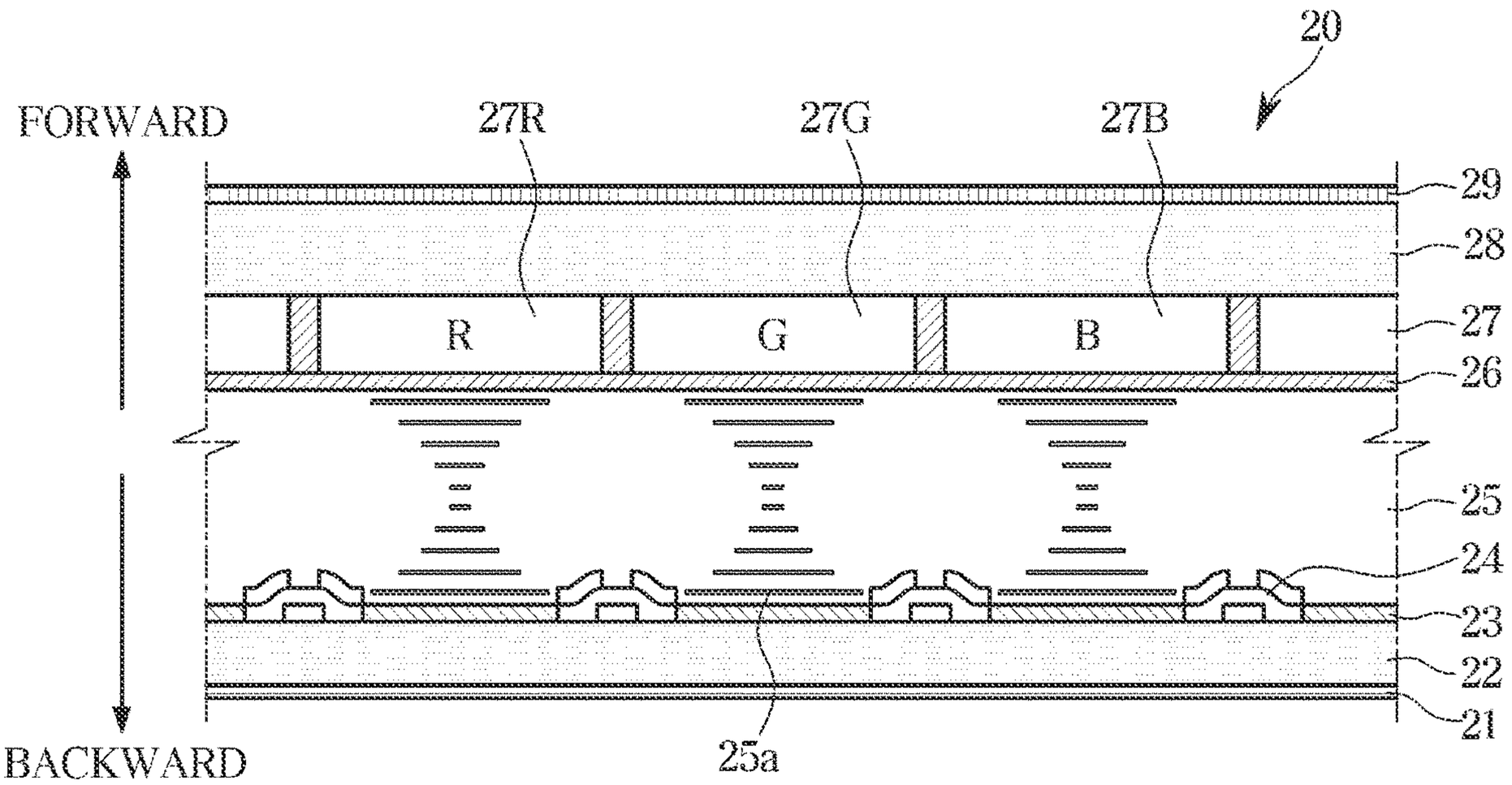

20
FORWARD
27R
27G
27B
29
28
R
G
B
27
26
25
24
23
22
21
25a
BACKWARD

FIG. 4

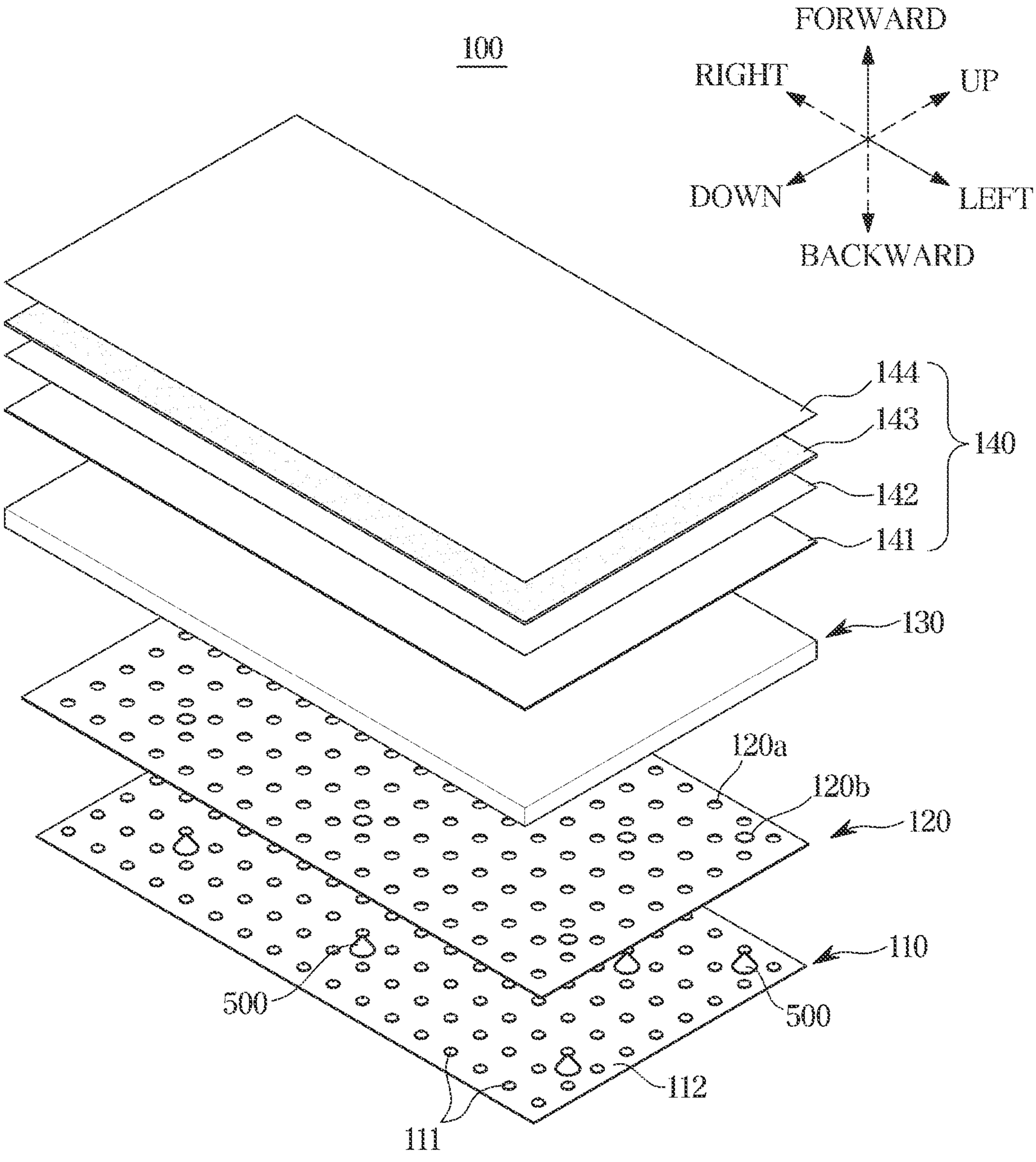

100
FORWARD
RIGHT
UP
DOWN
LEFT
BACKWARD
144
143
142
141
140
130
120a
120b
120
110
500
500
112
111

FIG. 5

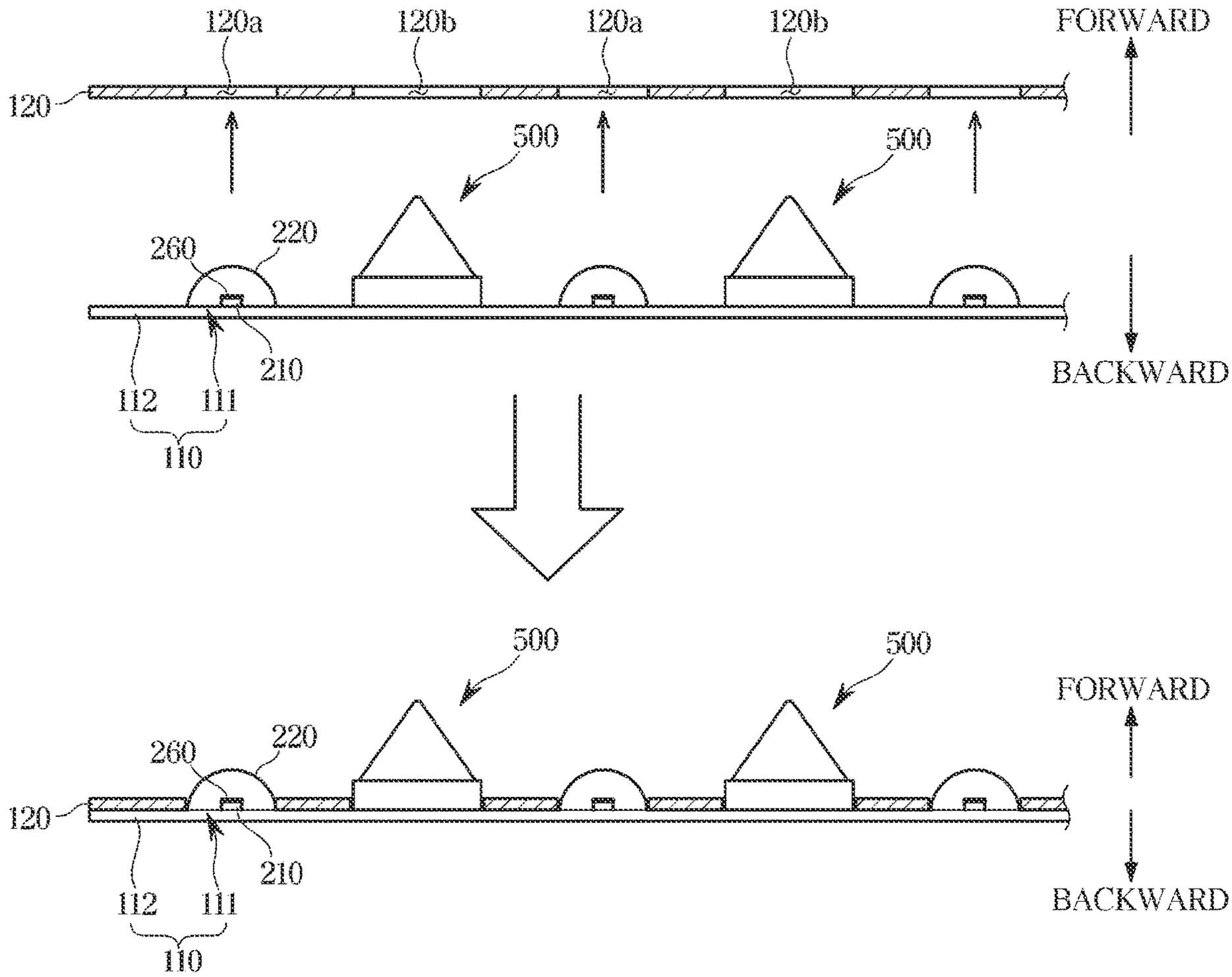

120a
120b
120a
120b
FORWARD
120
500
500
260
220
210
112
111
110
BACKWARD
500
500
FORWARD
260
220
120
210
112
111
110
BACKWARD

FIG. 6

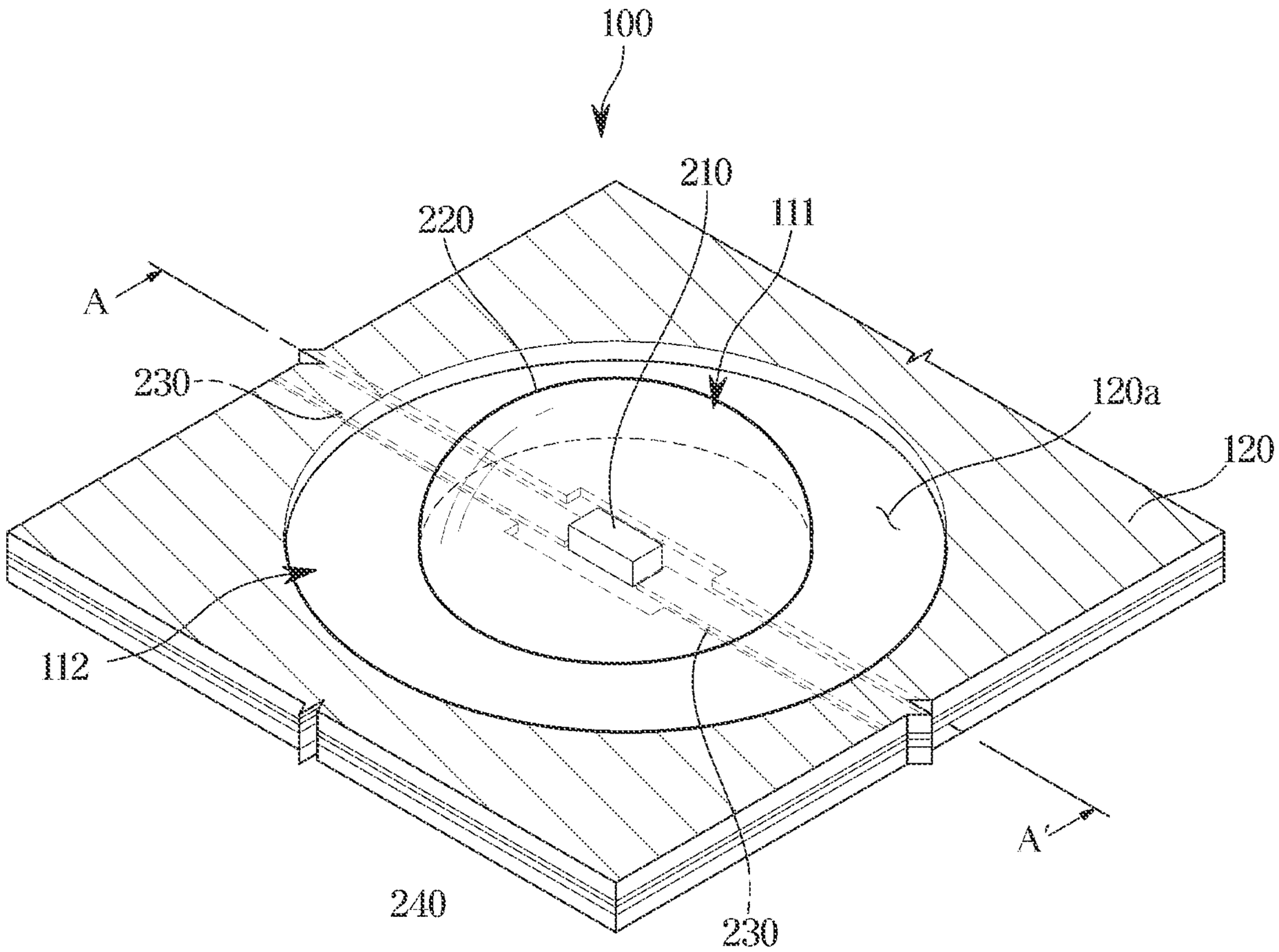


FIG. 7

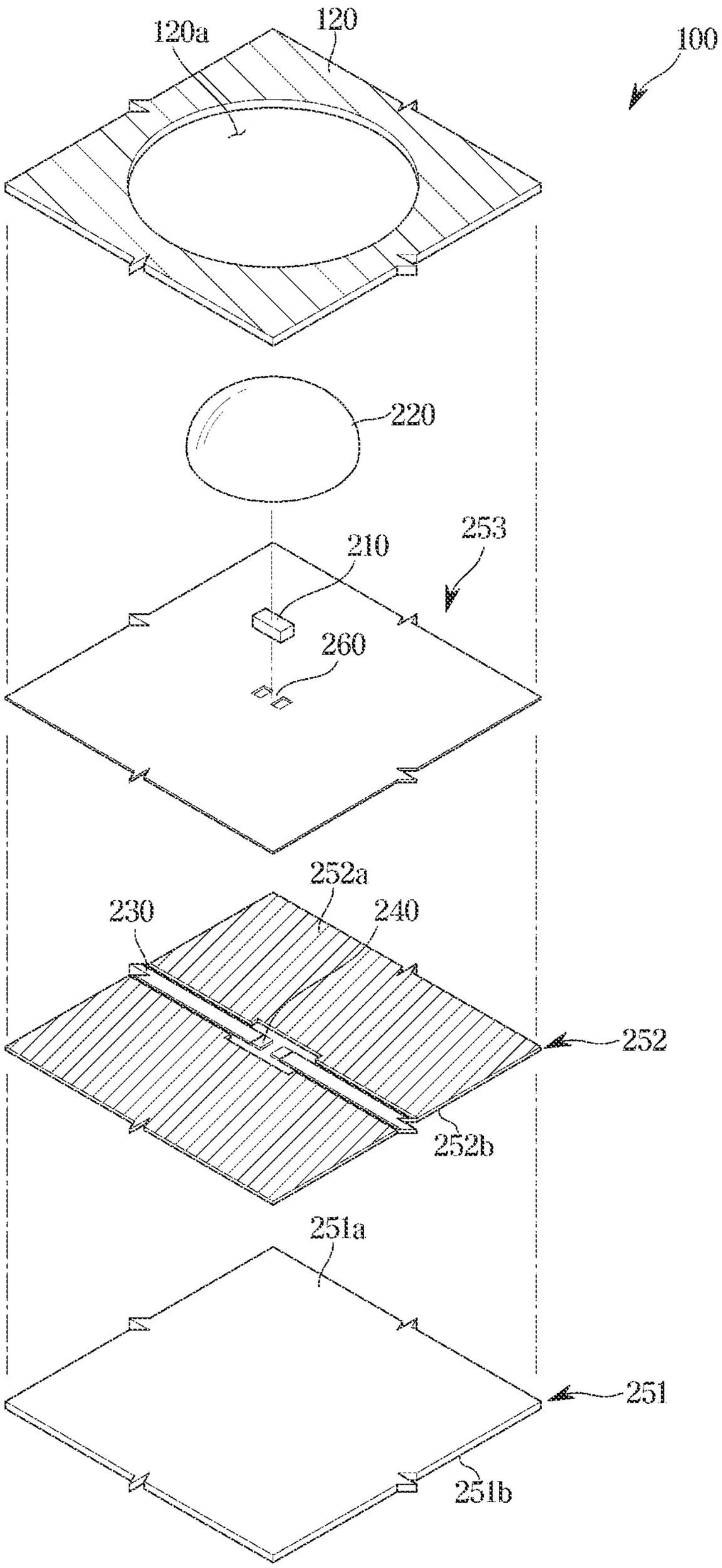

120a
120
100
220
210
253
260
252a
230
240
252
252b
251a
251
251b

FIG. 8

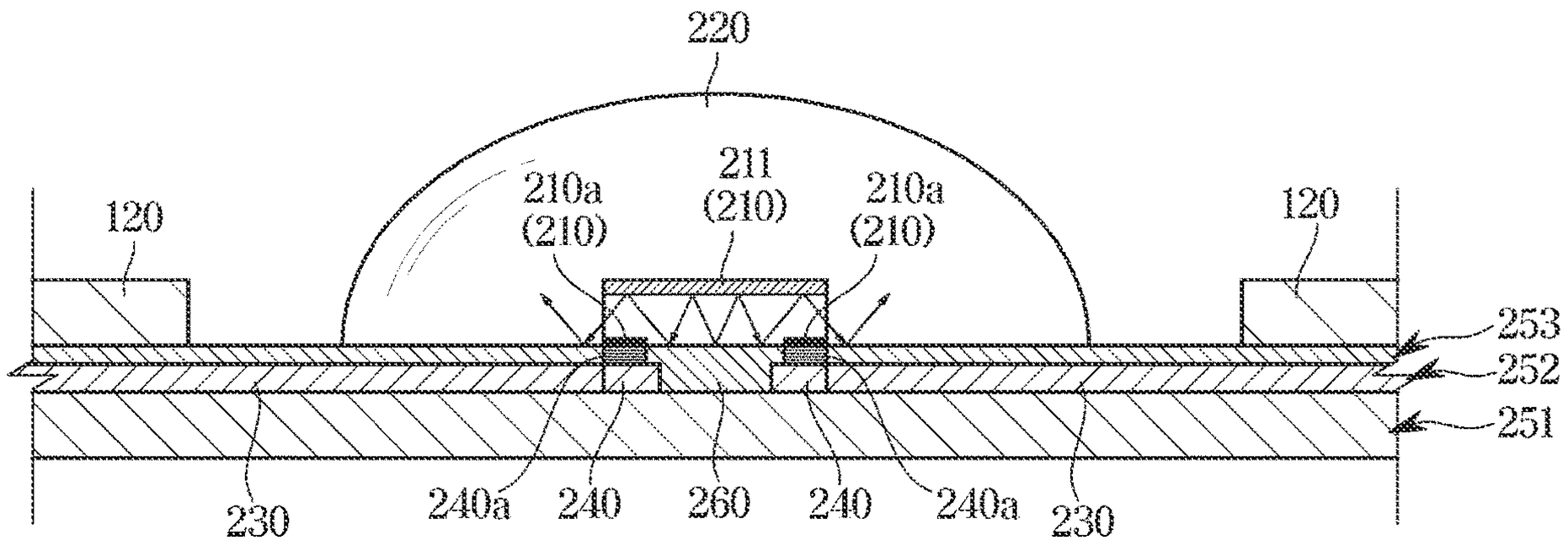

220
211
(210)
210a
(210)
210a
(210)
120
120
253
252
251
230
240a
240
260
240
240a
230

FIG. 9

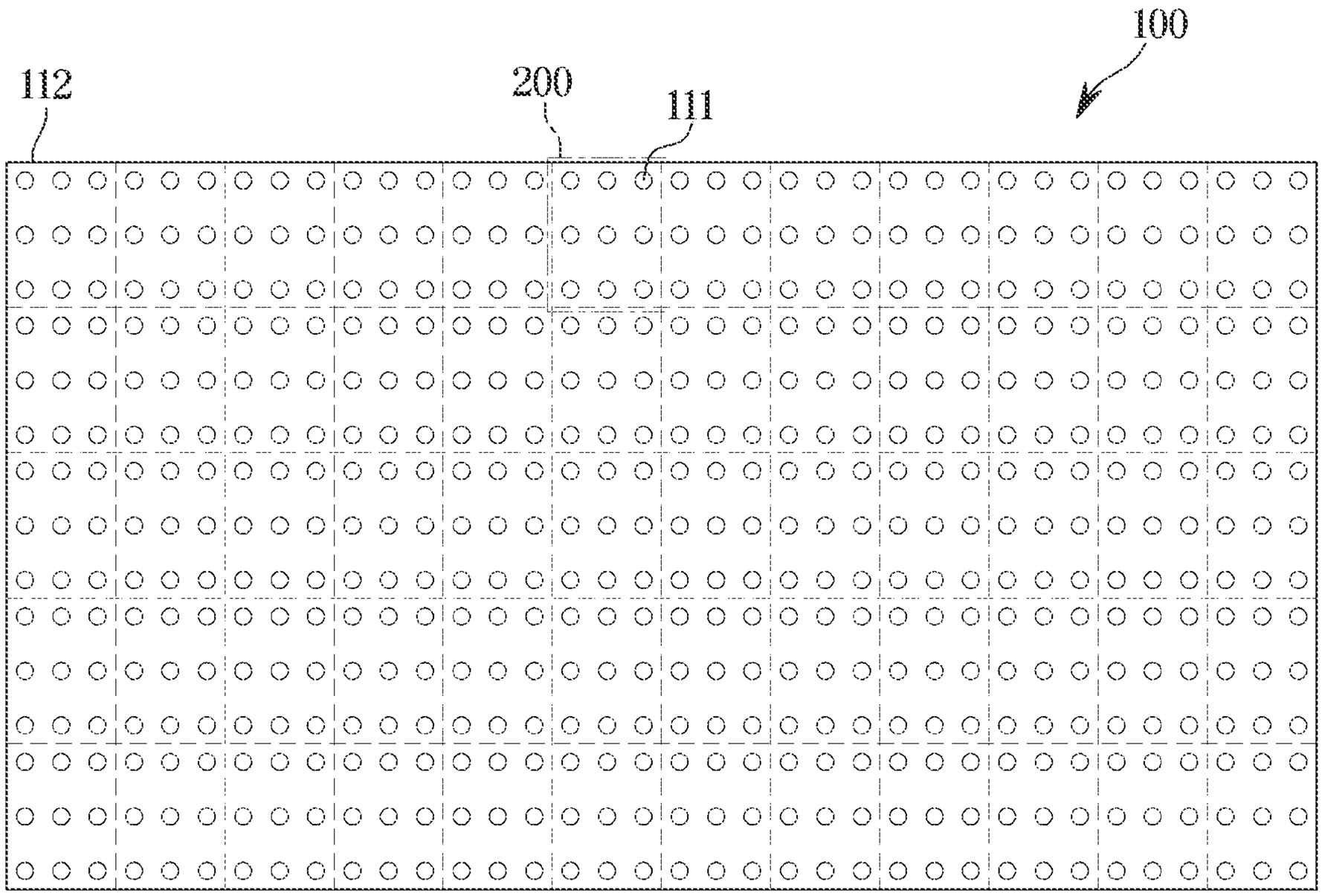


FIG. 10

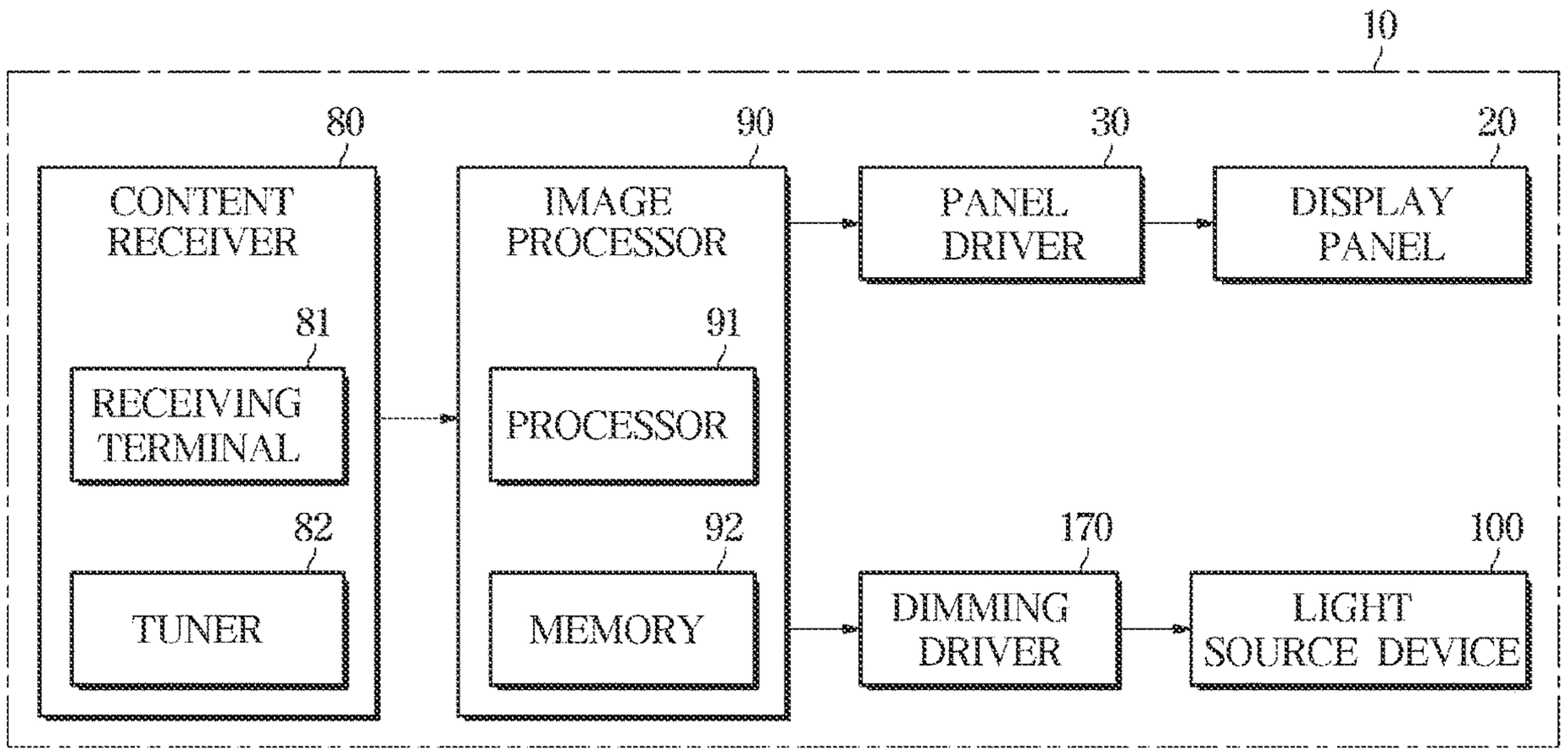
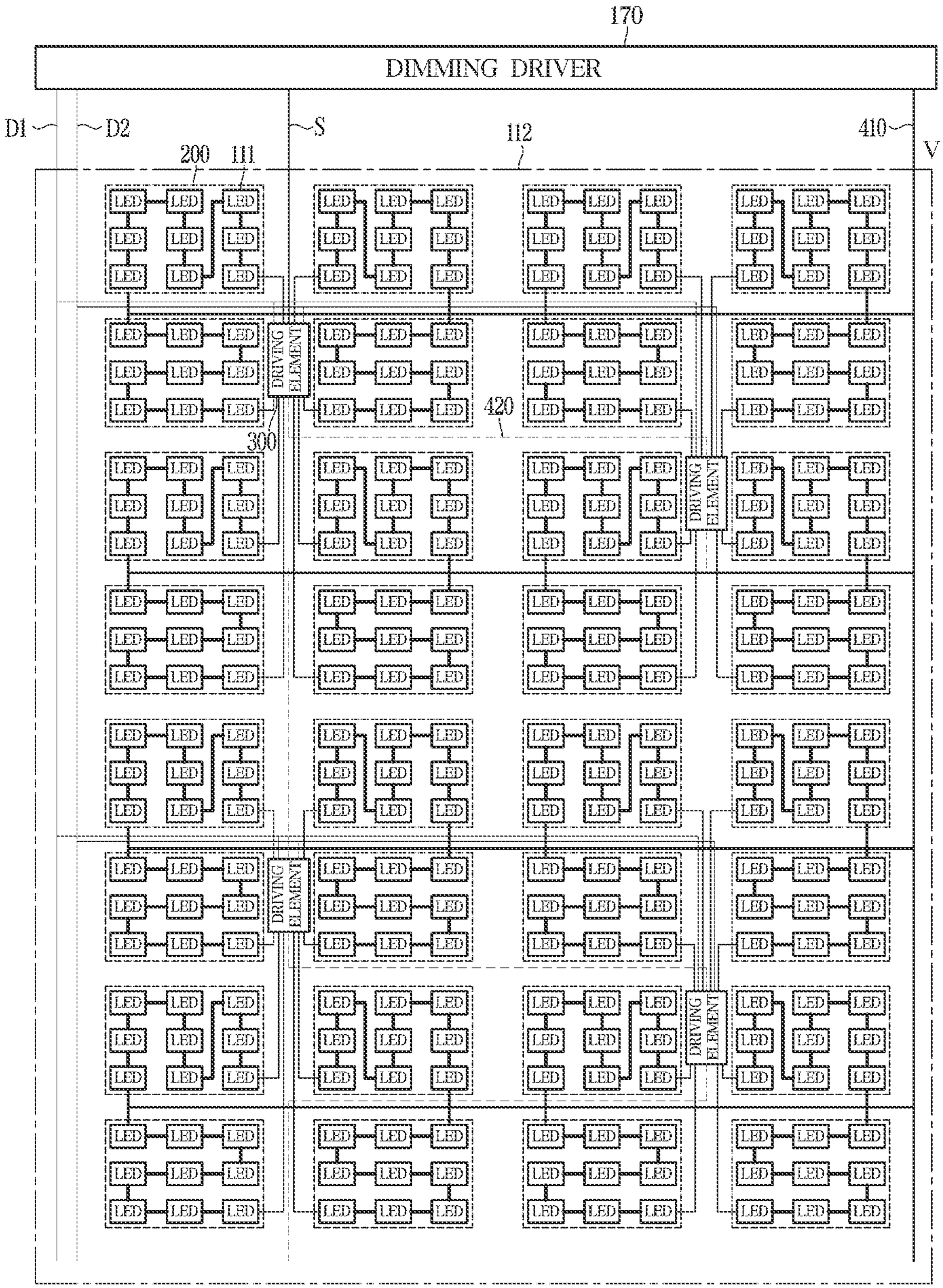

10
80
CONTENT RECEIVER
81
RECEIVING TERMINAL
82
TUNER
90
IMAGE PROCESSOR
91
PROCESSOR
92
MEMORY
30
PANEL DRIVER
20
DISPLAY PANEL
170
DIMMING DRIVER
100
LIGHT SOURCE DEVICE

FIG. 11



400 : 410,420,D,S

FIG. 12

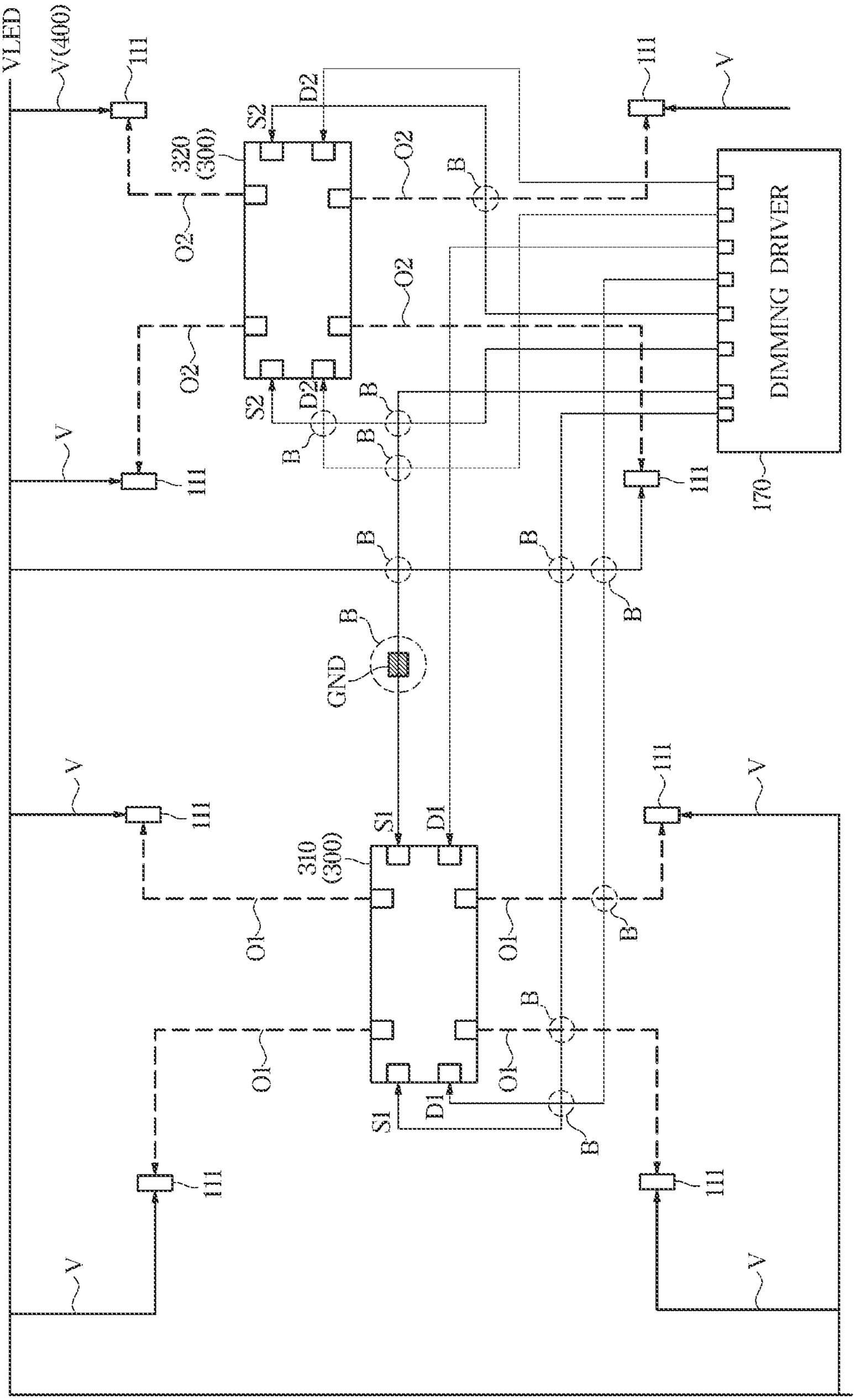

400:410,420,O,D,S
VLED
V(400)
111
320
(300)
S2
D2
O2
B
V
DIMMING DRIVER
170
GND
310
(300)
S1
D1
O1

FIG. 13

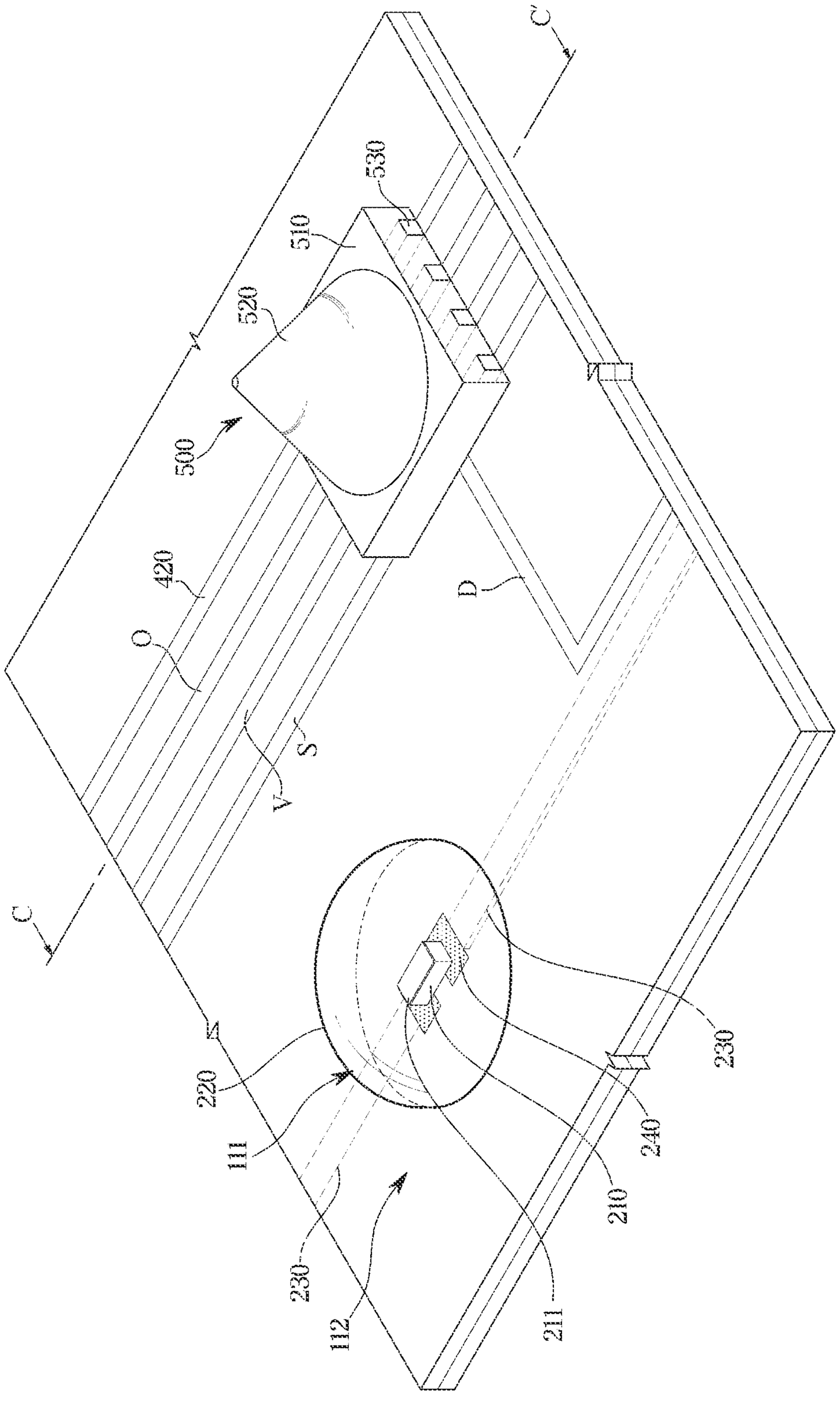


FIG. 14

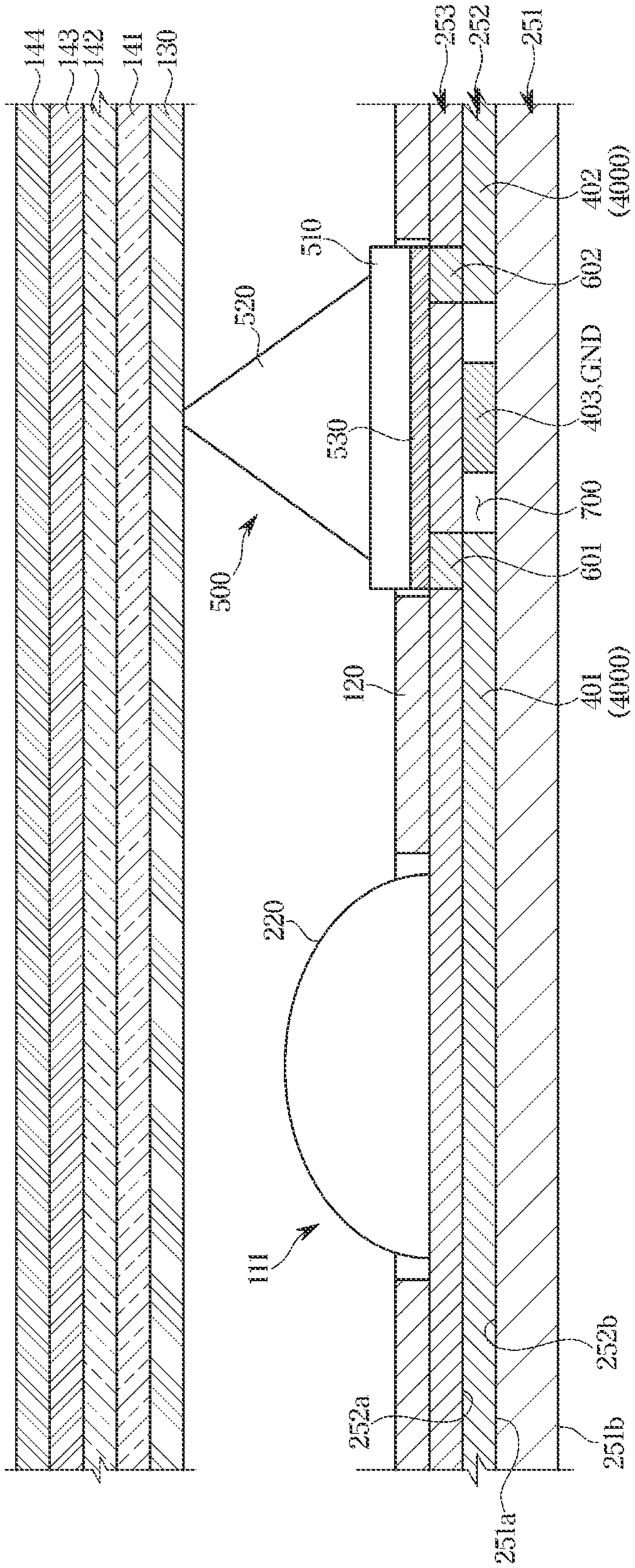

144
143
142
141
130
253
252
251
402
(4000)
510
602
520
530
403,GND
700
601
500
120
401
(4000)
220
111
252b
252a
251b
251a

FIG. 15

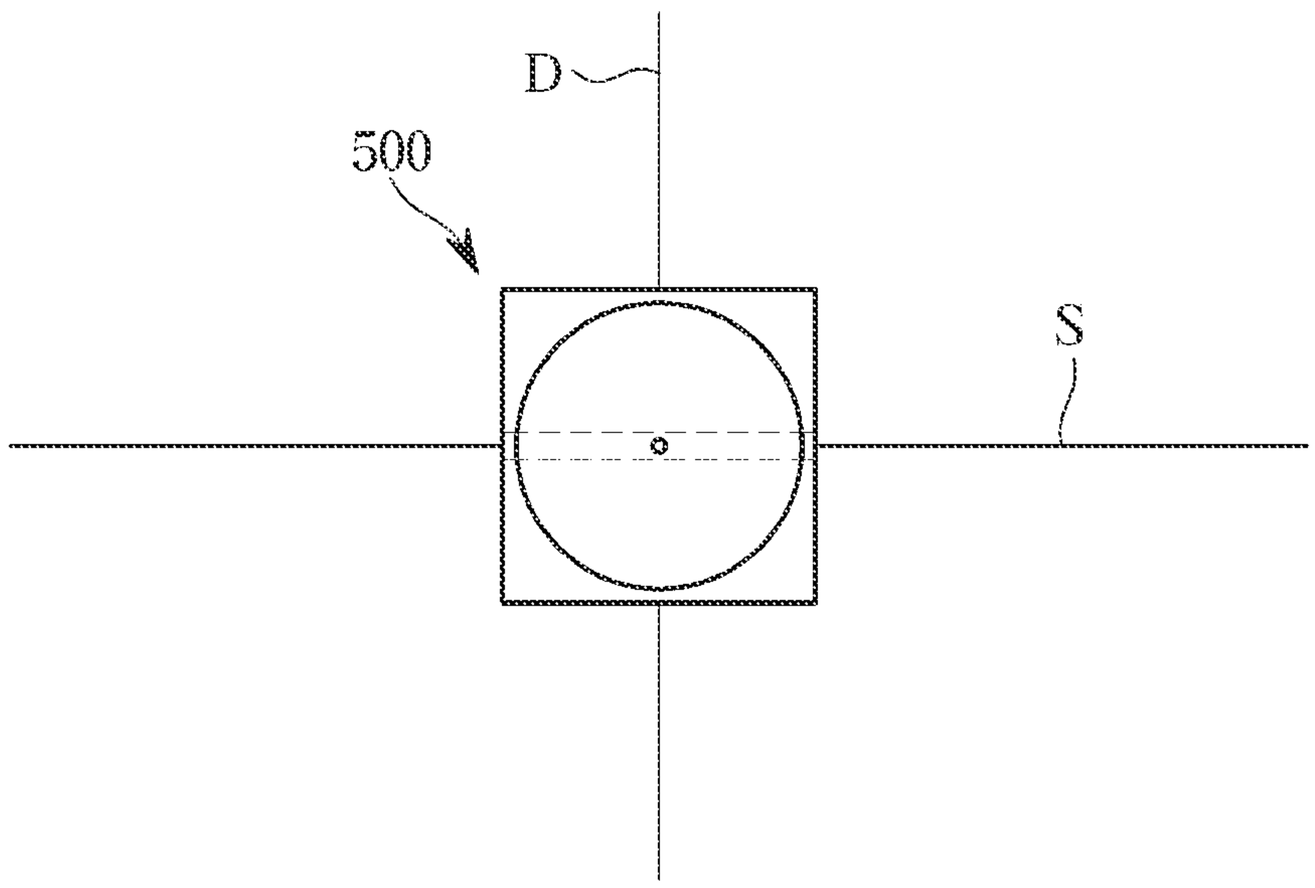


FIG. 16

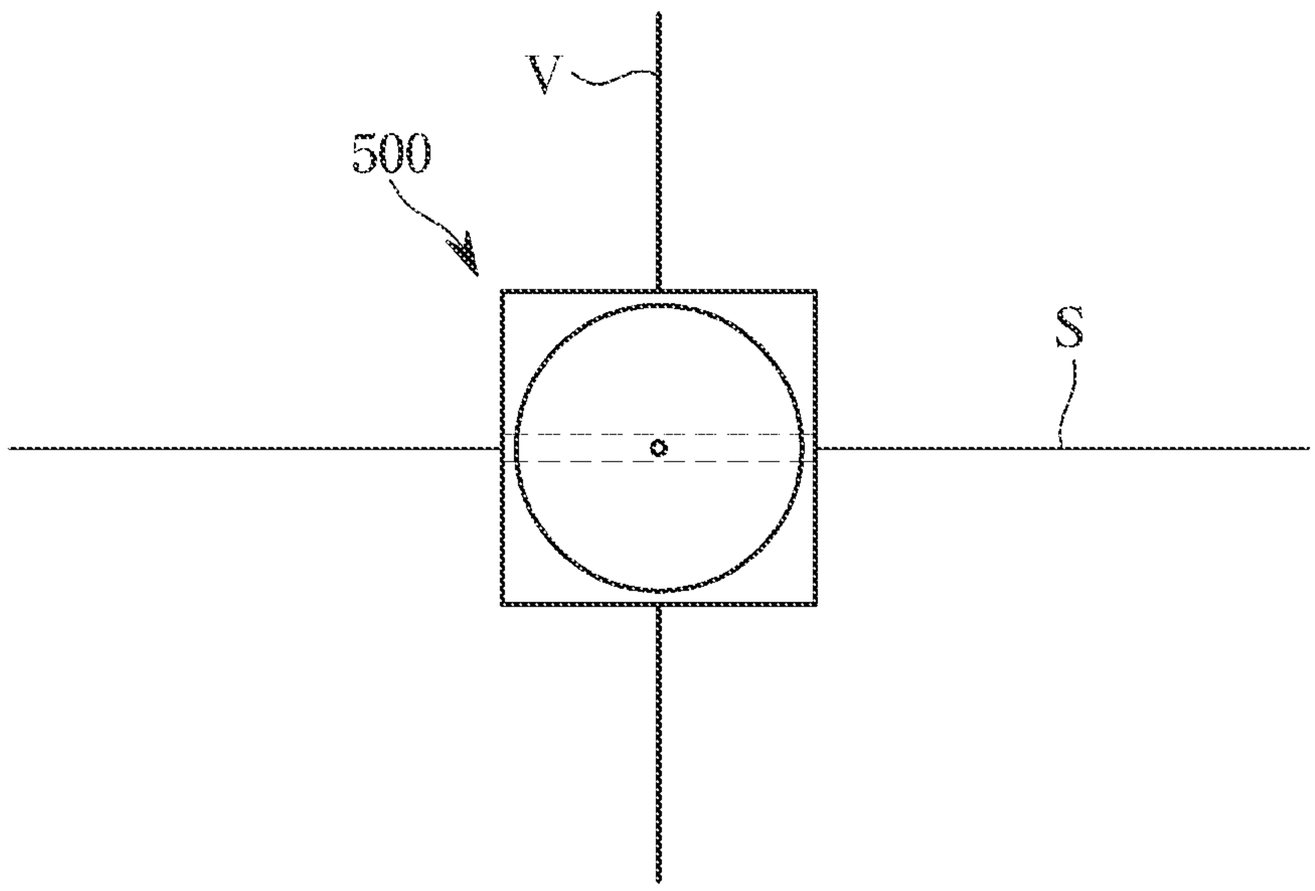


FIG. 17

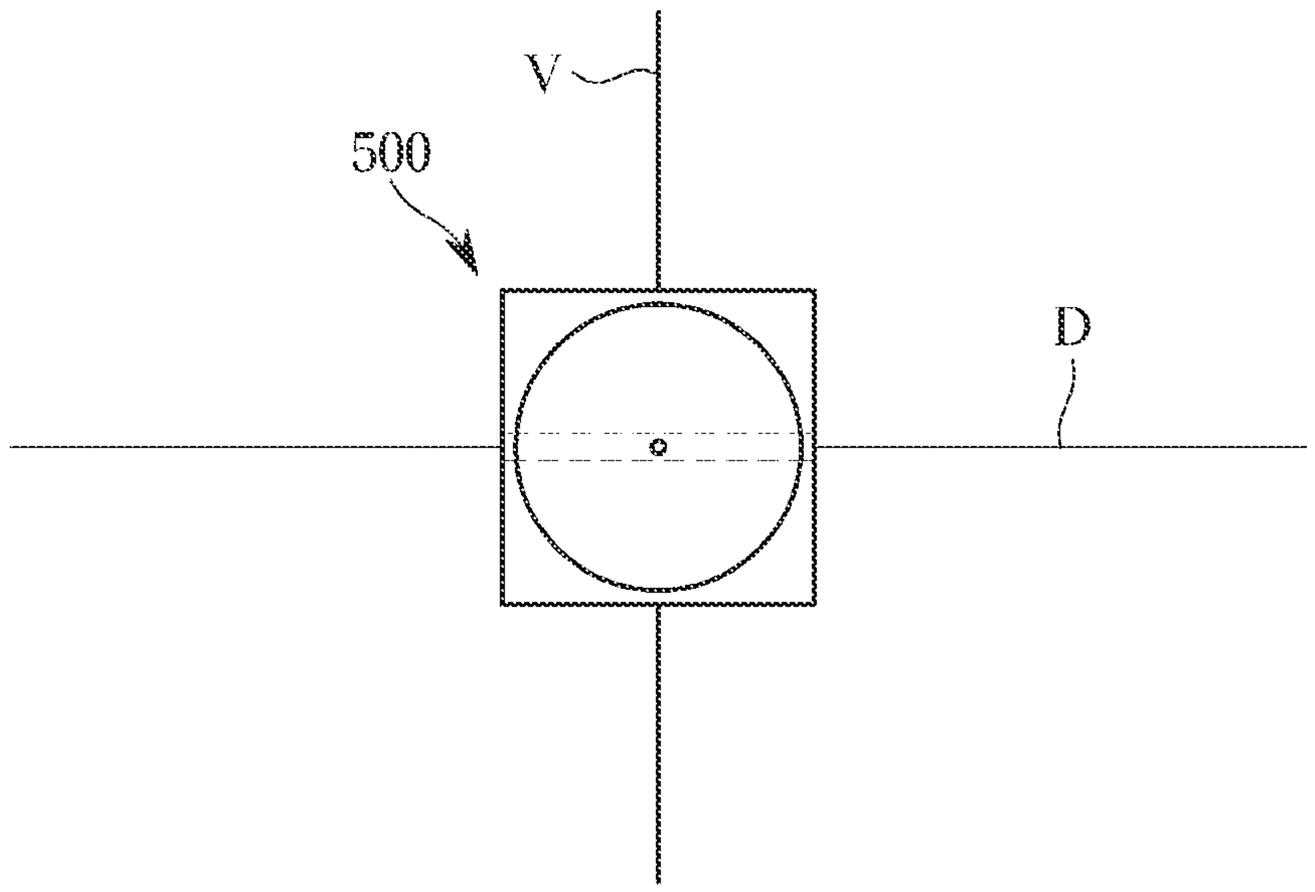


FIG. 18

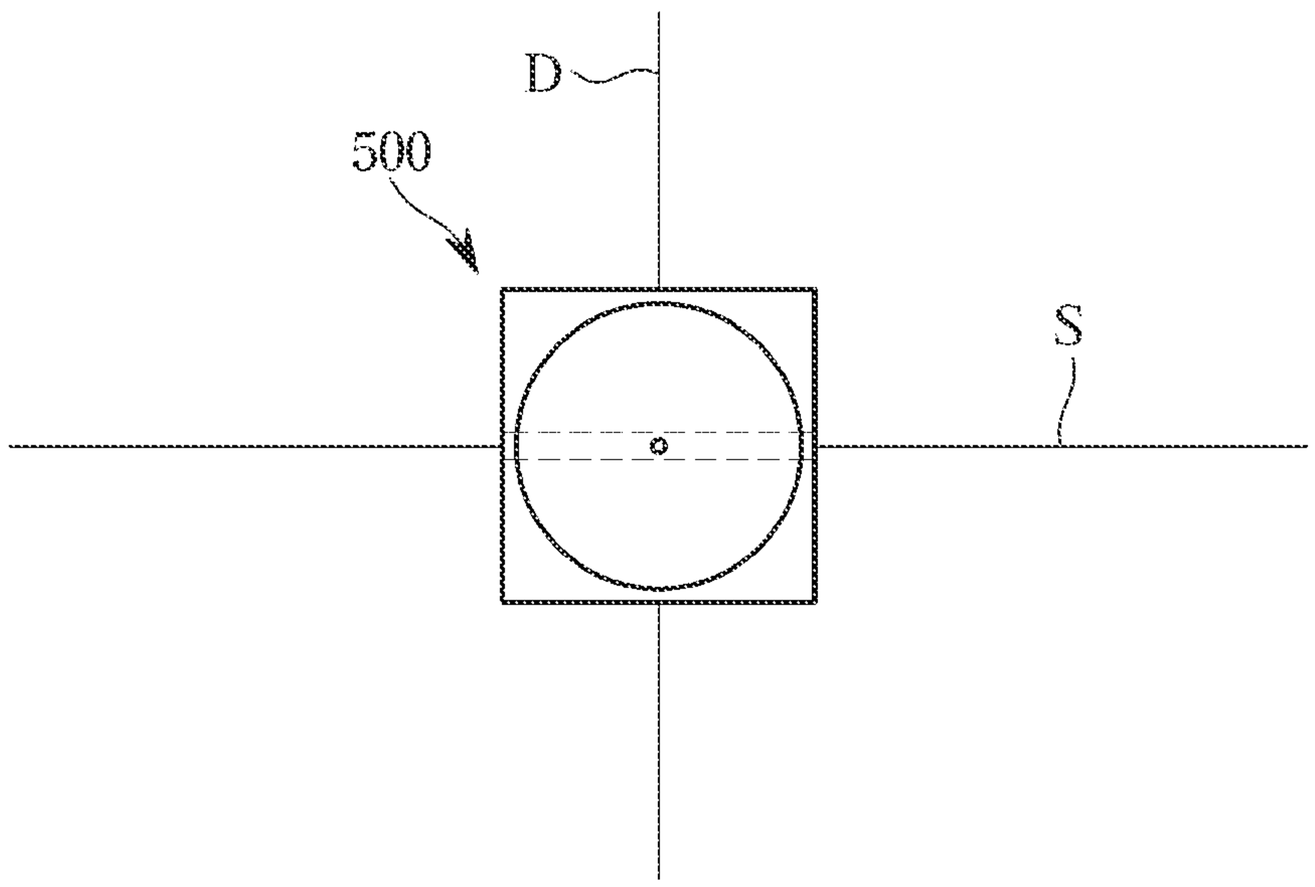


FIG. 19

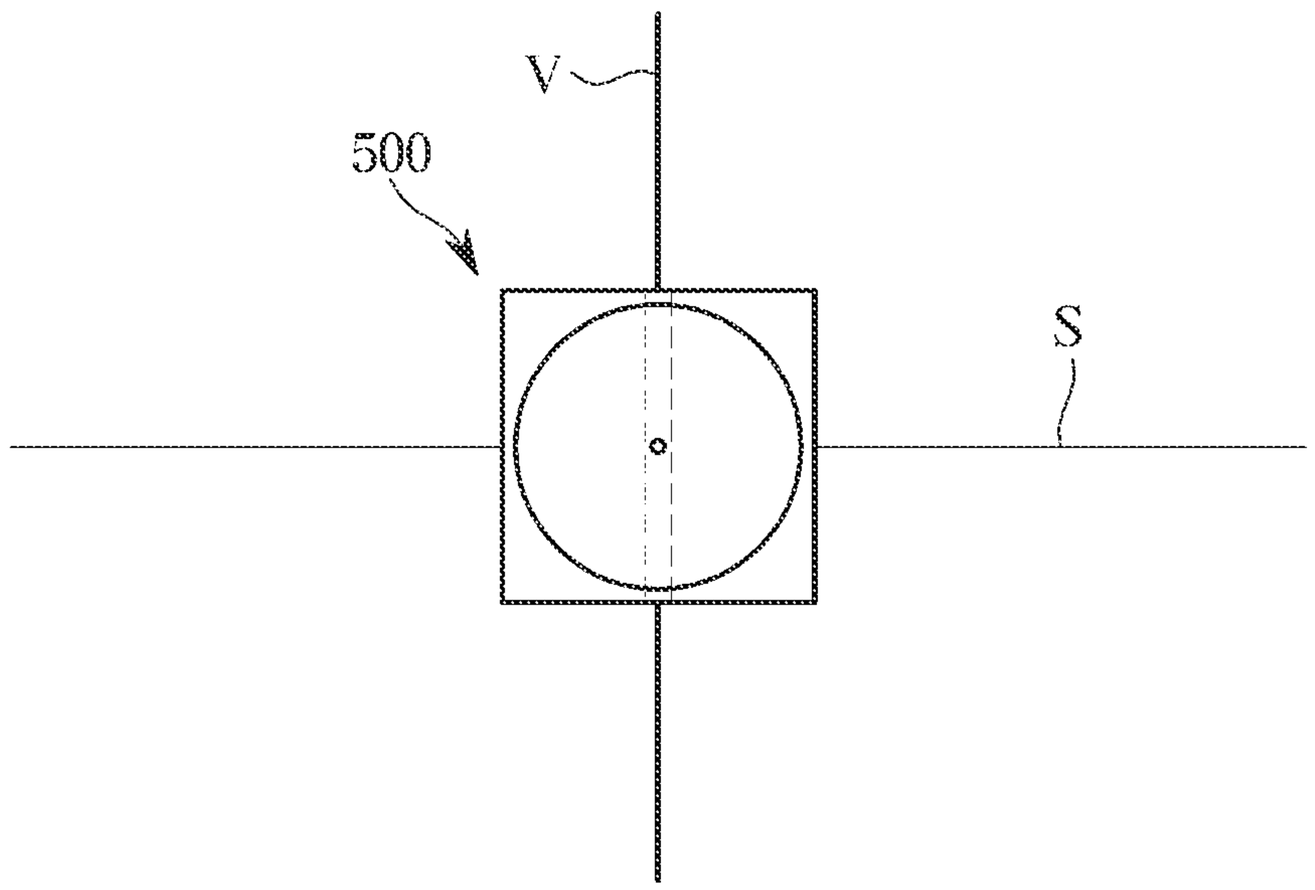


FIG. 20

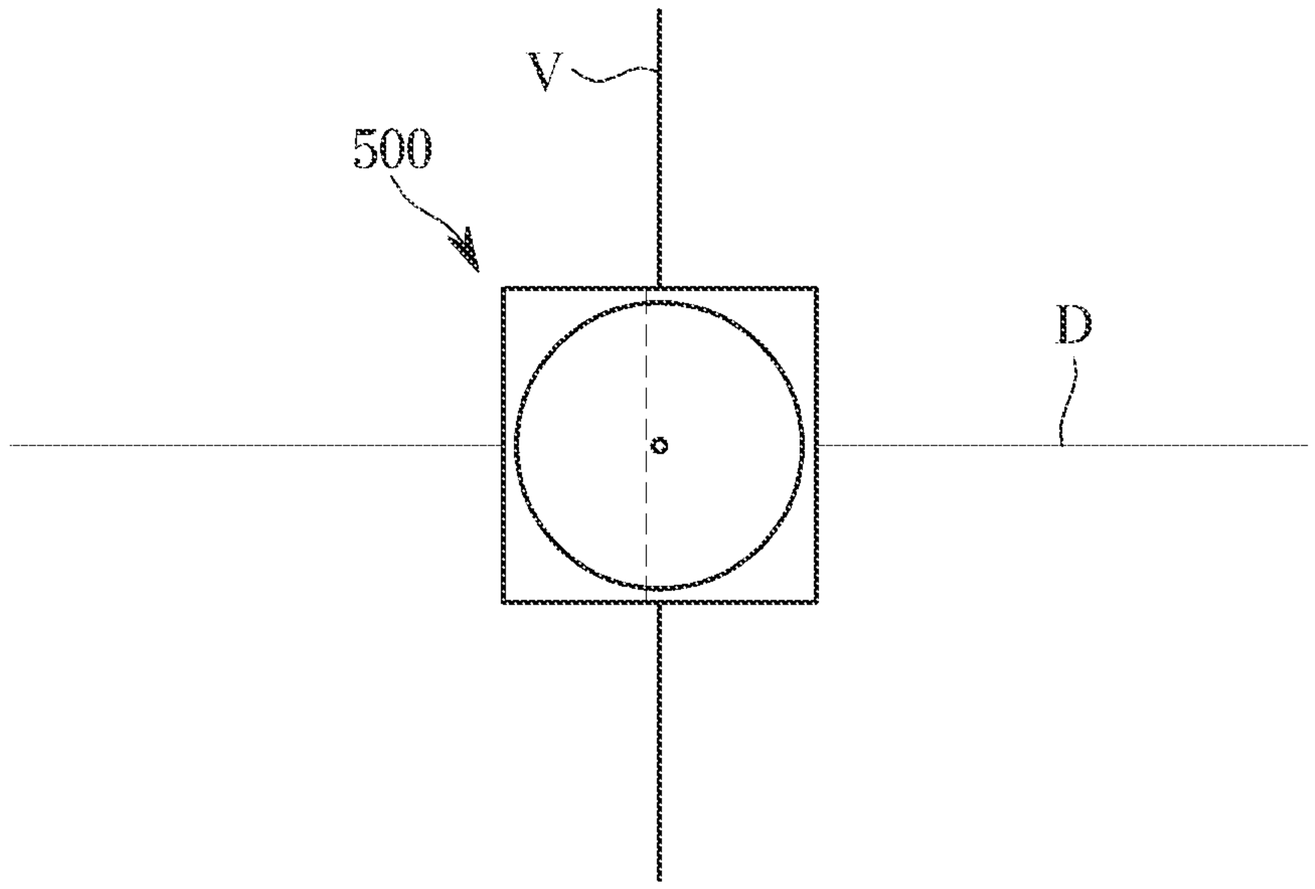


FIG. 21

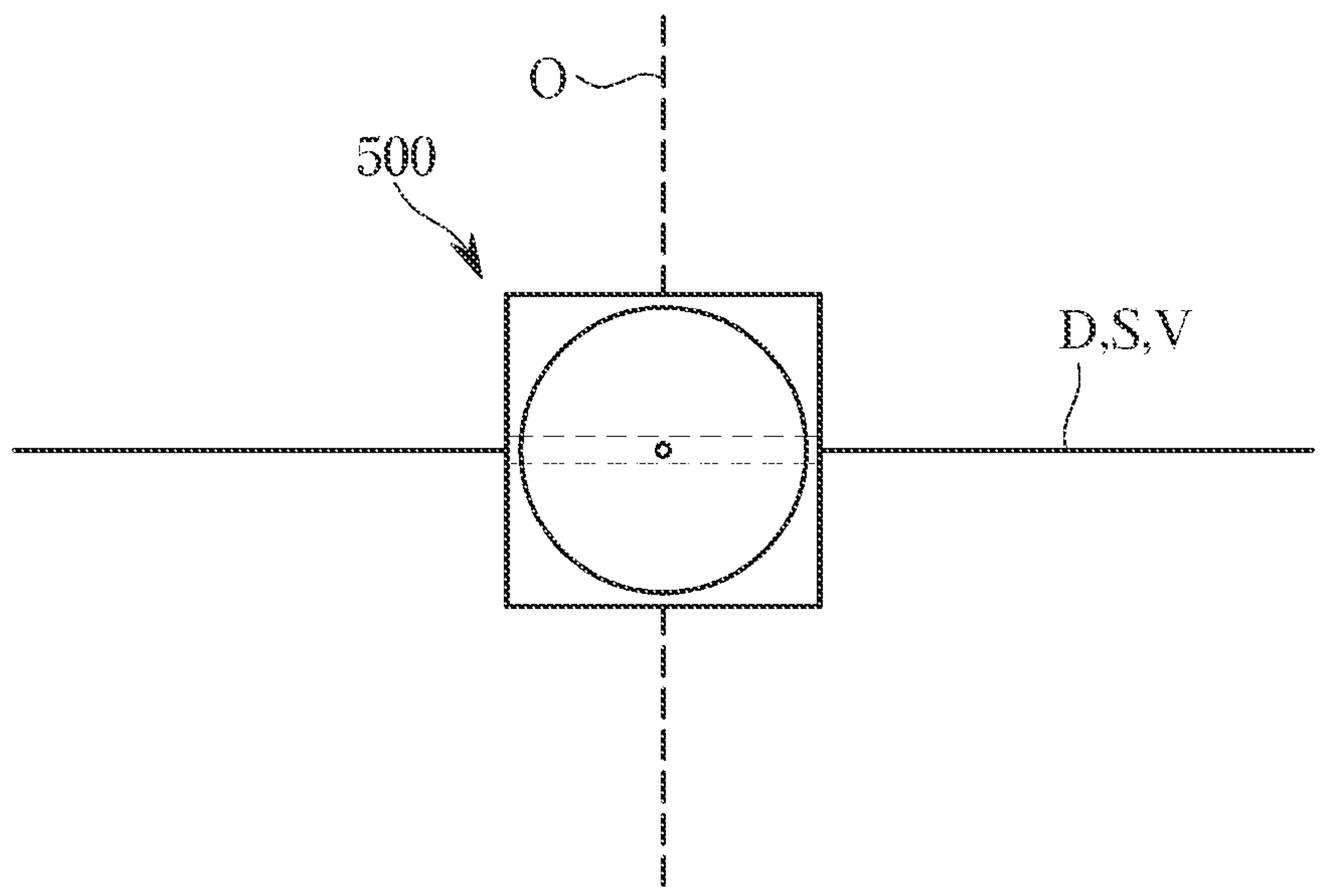
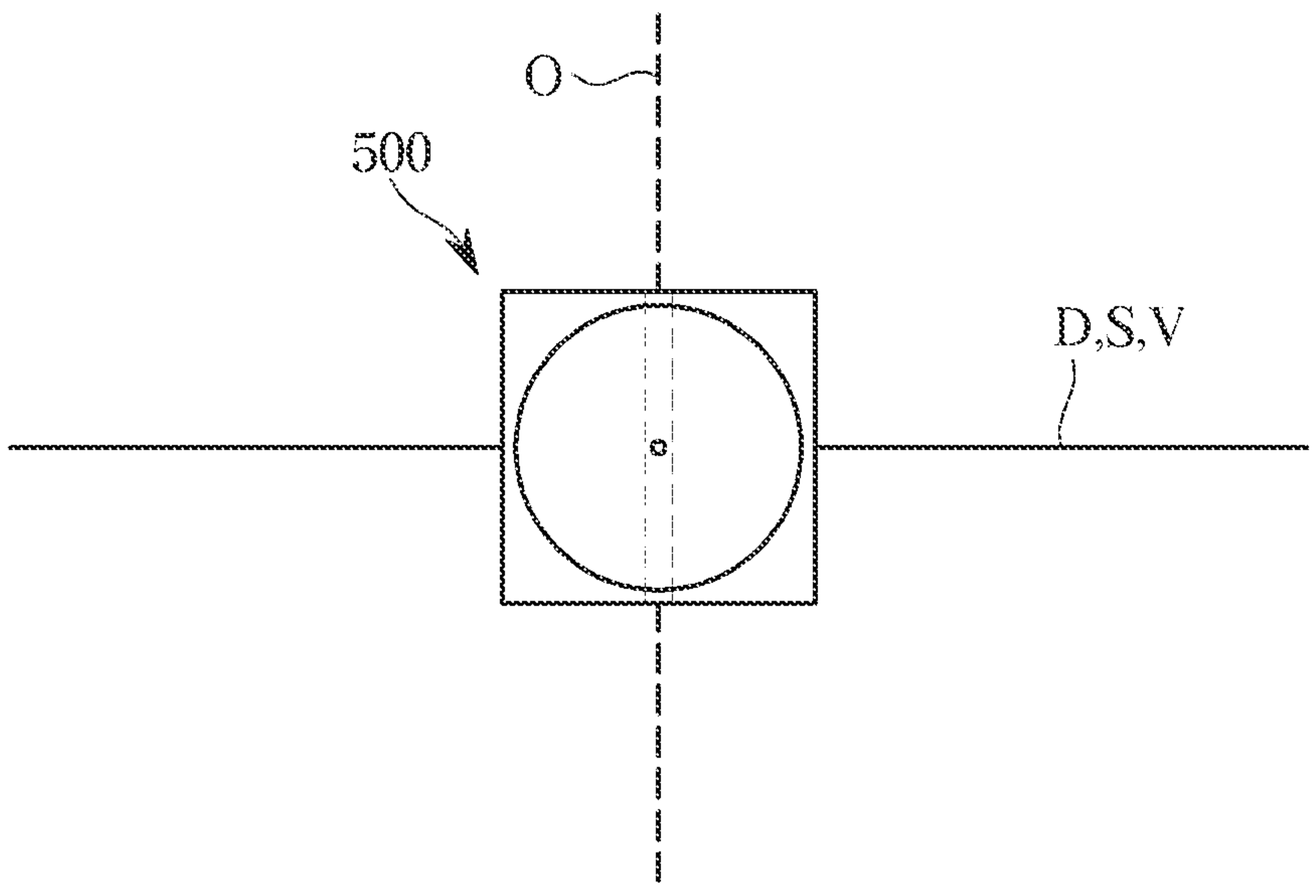


FIG. 22



DISPLAY APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a by-pass continuation of International Application No. PCT/KR2023/017836, filed on Nov. 8, 2023, which is based on and claims priority to Korean Patent Application No. 10-2023-0008331, filed on Jan. 19, 2023, in the Korean Intellectual Property Office, the disclosures of which are incorporated by reference herein in their entireties.

BACKGROUND

1. Field

The present disclosure relates to a display apparatus including an optical member and a supporter.

2. Description of Related Art

A display apparatus converts obtained or stored electrical information into visual information and displays the visual information on a screen.

Display apparatuses include a monitor apparatus connected to a personal computer or a server computer, a portable computer device, a navigation terminal device, a general television apparatus, an Internet Protocol television (IPTV), a portable terminal device, such as a smart phone, a tablet PC, a personal digital assistant (PDA) or a cellular phone, various display apparatuses used to reproduce images, such as advertisements or movies in an industrial field, or various kinds of audio/video systems.

The display apparatus (whether a self-luminous display or a non-luminous display) includes a light source device to convert electrical information into visual information, and the light source device includes a plurality of light sources configured to independently emit light. Each of the plurality of light sources includes a light emitting diode (LED) or an organic light emitting diode (OLED).

Driving elements and light sources (e.g., light emitting diodes) may be fixed on a light source substrate using a surface mount technology (SMT). In addition, lines (wires) that connect the driving elements and the light sources to exchange electrical signals may be wired to the light source substrate, and a supporter that supports an optical member provided to improve optical characteristics of the light source device may be disposed on the light source substrate.

The substrate may include two outer surfaces. An outer surface of the substrate on which the light source and driving elements are mounted is different from an outer surface of the substrate on which connectors and capacitors are mounted, and accordingly, there is a demand to increase process efficiency when manufacturing light source devices. In other words, there has been a demand for single-sided printed circuit board (PCB)s.

SUMMARY

Provided is a display apparatus that may improve an efficiency of a production process.

Further, provided is a display apparatus which may have reduced production costs.

According to an aspect of the disclosure, a display apparatus includes: a display panel: and a light source device configured to provide light to the display panel, wherein the light source device may include: an optical member: a substrate including a first side facing the display panel and the optical member: a light source provided on the first side of the substrate: a driving element provided on the first side of the substrate and configured to drive the light source: a plurality of lines provided on the first side of the substrate, the plurality of lines including a first line and a second line that are connected to the driving element: and a jumper supporter provided on the first side of the substrate in an area where the first line intersects the second line, the jumper supporter being configured to support the optical member, to electrically connect the first line, and to guide the second line to be spaced apart from the first line.

The substrate may include: an insulation layer including a first side facing the optical member: and a conduction layer laminated on the first side of the insulation layer and including a first side facing the optical member, and the jumper supporter may be soldered to the first side of the conduction layer to electrically connect the first line.

The jumper supporter may include: a base provided on the conduction layer: a support portion protruded from the base and configured to support the optical member; and a connection portion provided on the base to electrically connect the first line.

The first line may include: a first portion: and a second portion disconnected from the first portion, and the connection portion of the jumper supporter connects the first portion and the second portion.

The second line may be between the insulation layer and the base of the jumper supporter.

The plurality of lines may further include: a scan line configured to provide a scan signal to the driving element: a data line configured to provide a data signal to the driving element: a power line configured to provide a power signal to the light source; and an out line configured to provide a signal from the driving element to the light source.

The jumper supporter may be a first jumper supporter provided in an area where the scan line intersects the data line.

The first line may be the scan line; and the second line may be the data line.

The light source device may further include a second jumper supporter provided in an area where the power line intersects the scan line.

The scan line may be electrically connected by the second jumper supporter; and the power line may be spaced apart from the scan line by the second jumper supporter.

The light source device may further include a third jumper supporter provided in an area where the power line intersects the data line.

The data line may be electrically connected by the third jumper supporter: and the power line may be spaced apart from the data line by the third jumper supporter.

The light source device may further include a fourth jumper supporter provided in an area where the out line intersects at least one of the data line, the scan line and the power line.

The out line may be electrically connected by the fourth jumper supporter; and at least one of the data line, the scan line and the power line may be spaced apart from the out line by the fourth jumper supporter.

The display apparatus may further include a dimming driver configured to transmit the scan signal, the data signal, and the power signal to the driving element, the driving element may include a first driving element and a second driving element, and the first driving element and the second driving element are respectively configured to receive the

scan signal, the data signal, and the power signal from the dimming driver, the scan line may include a first scan line connected to the first driving element and a second scan line connected to the second driving element, the data line may include a first data line connected to the first driving element and a second data line connected to the second driving element, and the jumper supporter may be provided in an area where at least one of the first scan line and the first data line intersects at least one of the second scan line and the second data line.

According to an aspect of the disclosure, a light source device includes: an optical member: a substrate including a first side facing the optical member; a light source provided on the first side of the substrate; a driving element provided on the first side of the substrate and configured to drive the light source: a plurality of lines provided on the first side of the substrate, wherein the plurality of lines may include a first line and a second line that are connected to the driving element: and a jumper supporter provided on the first side of the substrate in an area where the first line intersects the second line, the jumper supporter being configured to support the optical member, to electrically connect the first line, and to guide the second line to be spaced apart from the first line.

The first line may include a first portion and a second portion, the substrate may include: an insulation layer including a first side facing the optical member; and a conduction layer laminated on the first side of the insulation layer and including a first side facing the optical member, and the jumper supporter may be electrically connected to the first side of the conduction layer and electrically connects the first portion of the first line and the second portion of the first line.

The jumper supporter may include: a base provided on the conduction layer; a support portion protruded from the base and configured to support the optical member: and a connection portion provided on the base, and the connection portion of the jumper supporter connects the first portion of the first line to the second portion of the first line.

The second line may be between the insulation layer and the base of the jumper supporter.

The plurality of lines may further include a plurality of first lines which may include the first line, each first line of the plurality of first lines may include a first portion and a second portion, the substrate may include: an insulation layer including a first side facing the optical member: and a conduction layer laminated on the first side of the insulation layer and including a first side facing the optical member, the jumper supporter may include: a base provided on the conduction layer: a support portion protruded from the base and configured to support the optical member: and a plurality of connection portions provided on the base, each connection portion of the plurality of connection portions corresponds to a respective first line of the plurality of first lines, and each connection portion of the plurality of connection portions connects the first portion and the second portion of the respective first line corresponding to the connection portion, and the jumper supporter may be further configured to guide the second line to be spaced apart from each first line of the plurality of first lines.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects, features, and advantages of certain embodiments of the present disclosure will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a perspective view of a display apparatus according to an embodiment:

FIG. **2** is an exploded perspective view of the display apparatus according to an embodiment:

FIG. **3** is a cross-sectional view of a display panel included in the display apparatus according to an embodiment:

FIG. **4** is an exploded-perspective view of a light source device included in the display apparatus according to an embodiment:

FIG. **5** is a view illustrating a combination of a light source module and a reflective sheet included in the light source device shown in FIG. **4**:

FIG. **6** is a perspective view of a light source included in the light source device according to an embodiment:

FIG. **7** is an exploded perspective view of the light source shown in FIG. **6**:

FIG. **8** is a cross-sectional view of the light source and a substrate shown in FIG. **6** taken along a direction A-A':

FIG. **9** is a view illustrating a plurality of light sources divided into a plurality of dimming blocks in the display apparatus according to an embodiment:

FIG. **10** is a control block diagram of the display apparatus according to an embodiment:

FIG. **11** illustrates an example of a connection structure of a dimming driver, a driving element, and a dimming block, and line arrangement in the light source device in the display apparatus according to an embodiment:

FIG. **12** illustrates an example of line arrangement on the substrate of the display apparatus according to an embodiment:

FIG. **13** is a view illustrating a jumper supporter being electrically connected to the substrate in the display apparatus according to an embodiment;

FIG. **14** is a cross-sectional view of the jumper supporter and the substrate shown in FIG. **13** taken along a direction C-C'; and

FIGS. **15** through **22** are enlarged views schematically illustrating a region "B" shown in FIG. **12** which illustrate an arrangement relationship between lines in the display apparatus according to an embodiment.

DETAILED DISCLOSURE

Embodiments described in the disclosure and configurations shown in the drawings are merely examples of the embodiments of the disclosure, and may be modified in various different ways at the time of filing of the present application to replace the embodiments and drawings of the disclosure.

In addition, the same reference numerals or signs shown in the drawings of the disclosure indicate elements or components performing substantially the same function.

Also, the terms used herein are used to describe the embodiments and are not intended to limit and/or restrict the disclosure. The singular forms "a," "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. In this disclosure, the terms "including", "having", and the like are used to specify features, numbers, steps, operations, elements, components, or combinations thereof, but do not preclude the presence or addition of one or more of the features, elements, steps, operations, elements, components, or combinations thereof.

Herein, the expression "at least one of a, b or c" indicates "only a," "only b," "only c," "both a and b," "both a and c," "both b and c," or "all of a, b, and c."

It will be understood that, although the terms first, second, third, etc., may be used herein to describe various elements, but elements are not limited by these terms. These terms are only used to distinguish one element from another element. For example, without departing from the scope of the disclosure, a first element may be termed as a second element, and a second element may be termed as a first element. The term of "and/or" includes a plurality of combinations of relevant items or any one item among a plurality of relevant items.

Additionally, in the present disclosure, the meaning of "identical" includes properties that are similar to each other or are similar within a certain range. Also, "identical" means "substantially identical". It should be understood that "substantially identical" means that values that fall within the margin of error in manufacturing or values that fall within a range that has no meaning compared to the standard value are included in the scope of "identical".

In the following description, terms such as "unit", "part", "block", "member", and "module" indicate a unit for processing at least one function or operation. For example, those terms may refer to at least one process processed by at least one hardware such as Field Programmable Gate Array (FPGA), Application Specific Integrated Circuit (ASIC), at least one software stored in a memory or a processor.

In the following detailed description, the terms of "forward", "backward", "left side", "right side" and the like may be defined by the drawings, but the shape and the location of the component is not limited by the terms.

Reference will now be made in detail to embodiments of the disclosure, examples of which are illustrated in the accompanying drawings.

FIG. **1** is a perspective view of a display apparatus according to an embodiment.

Referring to FIG. **1**, a display apparatus **10** is a device that processes an image signal received from an outside and visually displays the processed image. Hereinafter, a case in which the display apparatus **10** is a television is exemplified, but embodiments of the disclosure are not limited thereto. For example, the display apparatus **10** may be implemented in various forms, such as a monitor, a portable multimedia device, and a portable communication device, and the display apparatus **10** is not limited in its shape as long as visually displaying an image.

The display apparatus **10** may be a large format display (LFD) installed outdoors, such as a roof of a building or a bus stop, but is not limited to the outside of a building. Thus, the display apparatus **10** according to an embodiment may be installed in any places as long as the display apparatus is accessed by a large number of people, even indoors, such as subway stations, shopping malls, movie theaters, companies, and stores.

The display apparatus **10** may receive content data including video signals and audio signals from various content sources and output video and audio corresponding to the video signals and the audio signals. For example, the display apparatus **10** may receive content data through a broadcast reception antenna or cable, receive content data from a content playback device, or receive content data from a content providing server of a content provider.

As illustrated in FIG. **1**, the display apparatus **10** includes a body **11**, and a screen **12** provided to display an image I.

The body **11** may form an appearance of the display apparatus **10**, and the body **11** may include a component configured to allow the display apparatus **10** to display the image I and to perform various functions. Although the body **11** shown in FIG. **1** is in the form of a flat plate, the shape of the body **11** is not limited thereto. For example, the body **11** may have a curved plate shape.

The screen **12** may be formed on a front surface of the body **11**, and display the image I. For example, the screen **12** may display a still image or a moving image. Further, the screen **12** may display a two-dimensional plane image or a three-dimensional image using binocular parallax of the user.

The screen **12** may include a display panel configured to transmit or block light emitted from a device such as a light source device.

A plurality of pixels P may be formed on the screen **12** and the image I displayed on the screen **12** may be formed by a combination of the lights emitted from the plurality of pixels P. For example, the image I may be formed on the screen **12** by combining light emitted from the plurality of pixels Pas a mosaic.

Each of the plurality of pixels P may emit different brightness and different color of light. In order to emit light in the various colors, the plurality of pixels P may include sub-pixels PR, PG, and PB, respectively.

The sub-pixels PR, PG, and PB may include a red sub pixel PR emitting red light, a green sub pixel PG emitting green light, and a blue sub pixel PB emitting blue light. For example, the red light may represent a light beam having a wavelength of approximately 700 nm (nanometers, one billionth of a meter) to 800 nm, the green light may represent a light beam having a wavelength of approximately 500 nm to 600 nm, and the blue light may represent a light beam having a wavelength of approximately 400 nm to 500 nm.

By combining the red light of the red sub pixel PR, the green light of the green sub pixel PG and the blue light of the blue sub pixel PB, each of the plurality of pixels P may emit different brightness and different color of light.

FIG. **2** is an exploded perspective view of the display apparatus according to an embodiment. FIG. **3** is a cross-sectional view of a display panel included in the display apparatus according to an embodiment.

Referring to FIGS. **2** and **3**, various components configured to generate the image I on the screen **12** may be provided inside the body **11**.

For example, the body **11** may include a light source device **100** that is a surface light source, a display panel **20** configured to block or transmit light emitted from the light source device **100**, a control assembly **50** configured to control an operation of the light source device **100** and the display panel **20**, and a power assembly **60** configured to supply power to the light source device **100** and the display panel **20**. Further, the body **11** may include a bezel **13**, a frame middle mold **14**, a bottom chassis **15** and a rear cover **16** which are provided to support the display panel **20**, the light source device **100**, the control assembly **50** and the power assembly **60**.

The light source device **100** may include a point light source configured to emit monochromatic light or white light. The light source device **100** may refract, reflect, and scatter light in order to convert light, which is emitted from the point light source, into uniform surface light. As mentioned above, the light source device **100** may refract, reflect, and scatter light emitted from the point light source, thereby emitting uniform surface light toward the front side. The light source device **100** may be referred to as a back light unit **100**.

The light source device **100** is described in more detail below.

The display panel **20** may be provided in front of the light source device **100** and block or transmit light emitted from the light source device **100** to form the image I.

A front surface of the display panel **20** may form the screen **12** of the display apparatus **10** described above, and the display panel **20** may form the plurality of pixels P. In the display panel **20**, the plurality of pixels P may independently block or transmit light from the light source device **100**. Further, the light transmitted through the plurality of pixels P may form the image I displayed on the screen **12**.

For example, as shown in FIG. **3**, the display panel **20** may include a first polarizing film **21**, a first transparent substrate **22**, a pixel electrode **23**, a thin film transistor (TFT) **24**, a liquid crystal layer **25**, a common electrode **26**, a color filter **27**, a second transparent substrate **28**, and a second polarizing film **29**.

The first transparent substrate **22** and the second transparent substrate **28** may fixedly support the pixel electrode **23**, the TFT **24**, the liquid crystal layer **25**, the common electrode **26**, and the color filter **27**. The first and second transparent substrates **22** and **28** may be formed of tempered glass or transparent resin.

The first polarizing film **21** and the second polarizing film **29** may be provided on the outside of the first and second transparent substrates **22** and **28**. Each of the first polarizing film **21** and the second polarizing film **29** may transmit specific polarized light and block (reflect or absorb) other polarized light. For example, the first polarizing film **21** may transmit light polarized in a first direction and block (reflect or absorb) other polarized light. In addition, the second polarizing film **29** may transmit light polarized in a second direction and block (reflect or absorb) other polarized light. In this case, the first direction and the second direction may be perpendicular to each other. Accordingly, polarized light passing through the first polarizing film **21** may not directly pass through the second polarizing film **29**.

The color filter **27** may be provided on an inner side of the second transparent substrate **28**. The color filter **27** may include a red filter **27**R transmitting red light, a green filter **27**G transmitting green light, and a blue filter **27**B transmitting blue light. The red filter **27**R, the green filter **27**G, and the blue filter **27**B may be disposed parallel to each other. A region occupied by the color filter **27** may correspond to the above-mentioned pixel P. A region occupied by the red filter **27**R may correspond to the red sub-pixel PR, a region occupied by the green filter **27**G may correspond to the green sub-pixel PG, and a region occupied by the blue filter **27**B may correspond to the blue sub-pixel PB.

The pixel electrode **23** may be provided on an inner side of the first transparent substrate **22**, and the common electrode **26** may be provided on an inner side of the second transparent substrate **28**. The pixel electrode **23** and the common electrode **26** may be formed of a metal material through which electricity is conducted, and the pixel electrode **23** and the common electrode **26** may generate an electric field to change the arrangement of liquid crystal molecules forming the liquid crystal layer **25**.

The TFT **24** may be provided in an inner side of the second transparent substrate **28**. The TFT **24** may be turned on (closed) or turned off (open) by image data provided from a panel driver **30**. Further, an electric field may be formed or removed between the pixel electrode **23** and the common electrode **26** depending on whether the TFT **24** is turned on (closed) or turned off (open).

The liquid crystal layer **25** may be formed between the pixel electrode **23** and the common electrode **26**, and the liquid crystal layer **25** may be filled with liquid crystal molecules **25***a*. Liquid crystals represent an intermediate state between a solid (crystal) and a liquid. Liquid crystals may exhibit optical properties according to changes in an electric field. For example, in the liquid crystal, the orientation of molecules forming the liquid crystal may change according to a change in an electric field. As a result, the optical properties of the liquid crystal layer **25** may vary depending on the presence or absence of the electric field passing through the liquid crystal layer **25**. For example, the liquid crystal layer **25** may rotate a polarization direction of light with respect to an optical axis depending on the presence or absence of an electric field. Accordingly, the polarization direction of the polarized light passing through the first polarizing film **21** may be rotated while passing through the liquid crystal layer **25**, and the polarized light may pass through the second polarizing film **29**.

A cable **20***a* configured to transmit image data to the display panel **20**, and a display driver integrated circuit (DDI) (hereinafter referred to as 'panel driver') **30** configured to process digital image data and output an analog image signal may be provided at one side of the display panel **20**.

The cable **20***a* may electrically connect the control assembly **50**/the power assembly **60** to the panel driver **30**, and may also electrically connect the panel driver **30** to the display panel **20**. The cable **20***a* may include a flexible flat cable or a film cable that is bendable.

The panel driver **30** may receive image data and power from the control assembly **50**/the power assembly **60** through the cable **20***a*. The panel driver **30** may provide the image data and driving current to the display panel **20** through the cable **20***a*.

In addition, the cable **20***a* and the panel driver **30** may be integrally implemented as a film cable, a chip on film (COF), or a tape carrier package (TCP). In other words, the panel driver **30** may be arranged on the cable **20***b*. However, embodiments of the disclosure are not limited thereto, and the panel driver **30** may be arranged on the display panel **20**.

The control assembly **50** may include a control circuit configured to control an operation of the display panel **20** and the light source device **100**. The control circuit may process a video signal and/or an audio signal received from an external content source, transmit image data to the display panel **20**, and transmit dimming data to the light source device **100**.

The power assembly **60** may include a power circuit configured to supply power to the display panel **20** and the light source device **100**. The power circuit may supply power to the control assembly **50**, the light source device **100** and the display panel **20**.

The control assembly **50** and the power assembly **60** may be implemented as a printed circuit board and various circuits mounted on the printed circuit board. For example, the power circuit may include a capacitor, a coil, a resistance element, a processor, and a power circuit board on which the capacitor, the coil, the resistance element, and the processor are mounted. Further, the control circuit may include a memory, a processor, and a control circuit board on which the memory and the processor are mounted.

The light source device **100** will be described.

FIG. **4** is an exploded-perspective view of a light source device included in the display apparatus according to an embodiment. FIG. **5** is a view illustrating a combination of a light source module and a reflective sheet included in the light source device shown in FIG. **4**.

Referring to FIGS. **4** and **5**, the light source device **100** may include a light source module **110** configured to gen-

erate light, a reflective sheet **120** configured to reflect light, a diffuser plate **130** configured to uniformly diffuse light, and an optical sheet **140** configured to improve a luminance of light that is emitted.

The light source module **110** may include a plurality of light sources **111** configured to emit light, and a light source substrate **112** provided to support/fix the plurality of light sources **111**. The light source substrate **112** may be referred to as a substrate **112**.

The plurality of light sources **111** may be disposed in a predetermined pattern to emit light with the uniform luminance. The plurality of light sources **111** may be disposed in such a way that a distance between one light source and light sources adjacent thereto is the same.

The light source **111** may employ an element configured to emit monochromatic light (light of a specific wavelength, for example, blue light) or white light (for example, light of a mixture of red light, green light, and blue light) in various directions by receiving power. For example, the light source **111** may include a light emitting diode (LED).

The substrate **112** may fix the plurality of light sources **111** to prevent a change in the position of the light source **111**. Further, the substrate **112** may supply power, which is for the light source **111** to emit light, to the light source **111**.

The substrate **112** may fix the plurality of light sources **111** and may be configured with synthetic resin or tempered glass or a printed circuit board (PCB) on which a conductive power supply line for supplying power to the light source **111** is formed.

The substrate **112** may be composed of an insulation layer formed of synthetic resin or tempered glass. A circuit may be printed on one side of the substrate **112**. For example, a circuit pattern and/or line may be formed on a front surface of the substrate **112** facing the display panel **20**.

The display apparatus according to an embodiment may further include a supporter **500**. The supporter **500** may be installed on the substrate **112**. The supporter **500** may be mounted on an upper surface of the substrate **112** by soldering. The supporter **500** may be provided in plurality. The plurality of supporters **500** may be disposed between the substrate **112** and the optical members **130** and **140**. The plurality of supporters **500** may be mounted on the upper surface of the substrate **112** to support the optical members **130** and **140**.

The supporter **500** may be provided to maintain optical characteristics of the light source device **100** by maintaining an optical distance (OD) between the light source **111** and the diffuser plate **130** and/or the optical sheet **140**. The supporter **500** may be provided at a length capable of maintaining the optical characteristics of the light source device **100**.

The supporter **500** may be a jumper supporter **500** that is disposed in a region, in which circuit patterns intersect each other, so as to allow the circuit patterns to be connected to each other without interference. For example, the jumper supporter **500** may be disposed in a region, in which the plurality of lines **400** intersects each other, so as to allow the plurality of lines **400** to be connected to each other without interference. Because the jumper supporter **500** allows the lines **400** provided on one side of the substrate **112** to intersect each other while supporting the optical members **130** and **140**, it is possible to reduce the number of jumper connectors that is needed in the region where the lines intersect. Therefore, by reducing the number of jumper connectors, it is possible to reduce costs and improve process efficiency. Details about the jumper supporter **500** will be described later.

The reflective sheet **120** may reflect light emitted from the plurality of light sources **111** to the front side or in a direction close to the front side.

In the reflective sheet **120**, a plurality of through holes **120***a* is formed at positions corresponding to each of the plurality of light sources **111** of the light source module **110**. In addition, the light source **111** of the light source module **110** may pass through the through hole **120***a* and protrude to the front of the reflective sheet **120**.

Further, a plurality of supporter holes **120***b* may be formed in the reflective sheet **120** at positions corresponding to the supporter **500**. The supporter **500** may pass through the supporter hole **120***b* and protrude to support the diffuser plate and/or the optical sheet **140**. The supporter **500** may be disposed in the supporter hole **120***b*.

For example, as shown in the upper portion of FIG. **5**, in the process of assembling the reflective sheet **120** and the light source module **110**, the plurality of light sources **111** of the light source module **110** is inserted into the through holes **120***a* formed on the reflective sheet **120**, and the supporter **500** is inserted into the supporter hole **120***b*. Accordingly, as shown in the lower portion of FIG. **5**, the substrate **112** of the light source module **110** may be disposed behind the reflective sheet **120**, but the plurality of light sources **111** of the light source module **110** may be disposed in front of the reflective sheet **120**. Accordingly, the plurality of light sources **111** may emit light in front of the reflective sheet **120**.

The plurality of light sources **111** may emit light in various directions in front of the reflective sheet **120**. The light may be emitted not only toward the diffuser plate **130** from the light source **111**, but also toward the reflective sheet **120** from the light source **111**. The reflective sheet **120** may reflect light, which is emitted toward the reflective sheet **120**, toward the diffuser plate **130**.

Light emitted from the light source **111** may pass through various objects, such as the diffuser plate **130** and the optical sheet **140**. Among incident light beams passing through the diffuser plate **130** and the optical sheet **140**, some of the incident light beams may be reflected from the surfaces of the diffuser plate **130** and the optical sheet **140**. The reflective sheet **120** may reflect light reflected by the diffuser plate **130** and the optical sheet **140**.

The diffuser plate **130** may be provided in front of the light source module **110** and the reflective sheet **120**, and may evenly distribute the light emitted from the light source **111** of the light source module **110**.

Within the diffuser plate **130**, the diffuser plate **130** may diffuse light emitted from the plurality of light sources **111** to remove unevenness in luminance caused by the plurality of light sources **111**. In other words, the diffuser plate **130** may uniformly emit uneven light of the plurality of light sources **111** to the front surface.

The optical sheet **140** may include various sheets for improving the luminance and luminance uniformity. For example, the optical sheet **140** may include a diffusion sheet **141**, a first prism sheet **142**, a second prism sheet **143**, and a reflective polarizing sheet **144**.

The diffusion sheet **141** may diffuse light for the luminance uniformity. The light emitted from the light source **111** may be diffused by the diffuser plate **130** and may be diffused again by the diffusion sheet **141** included in the optical sheet **140**.

The first and second prism sheets **142** and **143** may increase the luminance by condensing light diffused by the diffusion sheet **141**. The first and second prism sheets **142** and **143** may include a prism pattern in the shape of a

triangular prism, and the prism pattern, which is provided in plurality, may be disposed adjacent to each other to form a plurality of strips.

The reflective polarizing sheet **144** is a type of polarizing film and may transmit some of the incident light beams and reflect others for improving the luminance. For example, the reflective polarizing sheet **144** may transmit polarized light in the same direction as a predetermined polarization direction of the reflective polarizing sheet **144**, and may reflect polarized light in a direction different from the polarization direction of the reflective polarizing sheet **144**. In addition, the light reflected by the reflective polarizing sheet **144** is recycled inside the light source device **100**, and thus the luminance of the display apparatus **10** may be improved by the light recycling.

The optical sheet **140** is not limited to the sheet or film shown in FIGS. **4** and **5** and may include more various sheets, such as a protective sheet, or films.

FIG. **6** is a perspective view of a light source included in the light source device according to an embodiment. FIG. **7** is an exploded-perspective view of the light source shown in FIG. **6**. FIG. **8** is a cross-sectional view of the light source and a substrate shown in FIG. **6** taken along a direction A-A.

Referring to FIGS. **6** to **8**, the light source module **110** may include the plurality of light sources **111**. The plurality of light sources **111** may protrude forward of the reflective sheet **120** from the rear of the reflective sheet **120** by passing through the through hole **120***a*. Accordingly, the light source **111** and a part of the substrate **112** may be exposed toward the front of the reflective sheet **120** through the through hole **120***a*.

The light source **111** may include an electrical/mechanical structure disposed in a region defined by the through hole **120***a* of the reflective sheet **120**. Each of the plurality of light sources **111** may include a light emitting diode **210** and an optical dome **220**.

It is possible to increase the number of light sources **111** to improve the uniformity of the surface light emitted from the light source device **100** and to improve the contrast ratio by the local dimming.

The light emitting diode **210** may include a P-type semiconductor and an N-type semiconductor for emitting light by recombination of holes and electrons. In addition, the light emitting diode **210** may be provided with a pair of electrodes **210***a* for supplying hole and electrons to the P-type semiconductor and the N-type semiconductor, respectively.

The light emitting diode **210** may convert electrical energy into optical energy. In other words, the light emitting diode **210** may emit light having a maximum intensity at a predetermined wavelength to which power is supplied. For example, the light emitting diode **210** may emit blue light having a peak value at a wavelength indicating blue color (for example, a wavelength between 450 nm and 495 nm).

The light emitting diode **210** may be directly attached to the substrate **112** in a Chip On Board (COB) method. In other words, the light source **111** may include the light emitting diode **210** in which a light emitting diode chip or a light emitting diode die is directly attached to the substrate **112** without an additional packaging.

In order to reduce a region occupied by the light emitting diode **210**, the light emitting diode **210** may be manufactured as a flip chip type that does not include a Zener diode. When attaching the flip-chip type light emitting diode **210**, which is a semiconductor device, to the substrate **112**, it is possible to fuse an electrode pattern of the semiconductor device to the substrate **112** as it is, without using an intermediate medium such as a metal lead (wire) or ball grid array (BGA).

Because the metal lead (wire) or ball grid array is omitted as mentioned above, it is possible to reduce the size of the light source **111** including the flip-chip type light emitting diode **210**.

The light source module **110**, in which the flip-chip type light emitting diode **210** is attached to the substrate **112** in a chip-on-board method to reduce the size of the light source **111**, may be manufactured.

In the above, the flip-chip type light emitting diode **210** that is directly fused to the substrate **112** in a chip-on board manner has been described, but the light source **111** is not limited to the flip-chip type light emitting diode. For example, the light source **111** may include a package type light emitting diode.

A feeding line **230** and a feeding pad **240** for supplying power to the light emitting diode **210** are provided on the substrate **112**.

The feeding line **230** for supplying electrical signals and/or power to the light emitting diode **210** from the control assembly **50** and/or the power assembly **60** is provided on the substrate **112**.

As shown in FIG. **8**, the substrate **112** may be formed by alternately laminating an insulation layer **251** that is non-conductive and a conduction layer **252** that is conductive.

The insulation layer **251** may include a first surface **251***a* and a second surface **251***b*, and the conduction layer **252** may also include a first surface **252***a* and a second surface **252***b*. The conduction layer **252** may be laminated on a first side of the insulation layer **251**. For example, the conduction layer **252** may be laminated on the first surface **251***a* of the insulation layer **251**. Further, the jumper supporter **500**, which will be described later, may be disposed on a first side of the conduction layer **252**. For example, the jumper supporter **500** may be disposed on the first surface **252***a* of the conduction layer **252** and the jumper supporter **500** may be electrically connected to the conduction layer **252** by soldering portions **601** and **602** so as to connect a first portion **401** and a second portion **402** of the line **400**.

A line or pattern, through which power and/or electrical signals pass, may be formed on the conduction layer **252**. The conduction layer **252** may be formed of various materials having an electrical conductivity. For example, the conduction layer **252** may be formed of various metal materials, such as copper (Cu), tin (Sn), aluminum (Al), or an alloy thereof. The conduction layer **252** may be laminated on one surface of the insulation layer **251**.

A dielectric of the insulation layer **251** may insulate between lines or patterns of the conduction layer **252**. The insulation layer **251** may be formed of a dielectric, such as FR-4, for electrical insulation.

The feeding line **230** may be implemented by a line or pattern formed on the conduction layer **252**. The feeding line **230** may be electrically connected to the light emitting diode **210** through the feeding pad **240**. The feeding pad **240** may be formed in such a way that the feeding line **230** is exposed to the outside.

A protection layer **253** configured to prevent or suppress damages caused by an external impact and/or damages caused by a chemical action (for example, corrosion, etc.) and/or damages caused by an optical action, to the substrate **112** may be formed at an outermost part of the substrate **112**. The protection layer **253** may include a photo solder resist (PSR).

As shown in FIG. **8**, the protection layer **253** may cover the feeding line **230** to prevent the feeding line **230** from being exposed to the outside.

For electrical contact between the feeding line **230** and the light emitting diode **210**, a window may be formed in the protection layer **253** to expose a portion of the feeding line **230** to the outside. A portion of the feeding line **230** exposed to the outside through the window of the protection layer **253** may form the feeding pad **240**.

A conductive adhesive material **240***a* for the electrical contact between the feeding line **230** exposed to the outside and the electrode **210***a* of the light emitting diode **210** may be applied to the feeding pad **240**. The conductive adhesive material **240***a* may be applied within the window of the protection layer **253**.

The electrode **210***a* of the light emitting diode **210** may be in contact with the conductive adhesive material **240***a*, and the light emitting diode **210** may be electrically connected to the feeding line **230** through the conductive adhesive material **240***a*.

The conductive adhesive material **240***a* may include a solder having an electrical conductivity. However, embodiments of the disclosure are not limited thereto, and the conductive adhesive material **240***a* may include electrically conductive epoxy adhesives.

Power may be supplied to the light emitting diode **210** through the feeding line **230** and the feeding pad **240**, and in response to the supply of the power, the light emitting diode **210** may emit light. A pair of feeding pads **240** corresponding to each of the pair of electrodes **210***a* provided in the flip-chip type light emitting diode **210** may be provided.

The optical dome **220** may cover the light emitting diode **210**. The optical dome **220** may prevent or suppress damages to the light emitting diode **210** caused by an external mechanical action and/or damages to the light emitting diode **210** caused by a chemical action.

The optical dome **220** may have a dome shape formed in such a way that a sphere is cut into a surface not including the center thereof, or may have a hemispherical shape in such a way that a sphere is cut into a surface including the center thereof. A vertical cross section of the optical dome **220** may be a bow shape or a semicircle shape.

The optical dome **220** may be formed of silicone or epoxy resin. For example, the molten silicon or epoxy resin may be discharged onto the light emitting diode **210** through a nozzle, and the discharged silicon or epoxy resin may be cured, thereby forming the optical dome **220**.

Accordingly, the shape of the optical dome **220** may vary depending on the viscosity of the liquid silicone or epoxy resin. For example, when manufacturing the optical dome **220** using silicon having a thixotropic index of about 2.7 to 3.3 (appropriately, 3.0), the optical dome **220** may have a dome ratio, indicating a ratio of a height of a dome to a diameter of a base of the dome (a height of the dome/a diameter of a base), of approximately 0.25 to 0.31 (appropriately 0.28). For example, the optical dome **220** formed of silicon having a thixotropic index of approximately 2.7 to 3.3 (appropriately, 3.0) may have a diameter of the base of approximately 2.5 mm and a height of approximately 0.7 mm.

The optical dome **220** may be optically transparent or translucent. Light emitted from the light emitting diode **210** may be emitted to the outside by passing through the optical dome **220**.

In this case, the dome-shaped optical dome **220** may refract light like a lens. For example, light emitted from the light emitting diode **210** may be refracted by the optical dome **220** and thus may be dispersed.

As mentioned above, the optical dome **220** may disperse light emitted from the light emitting diode **210** as well as protecting the light emitting diode **210** from external mechanical and/or chemical or electrical actions.

An antistatic member may be formed in a vicinity of the optical dome **220** to protect the light emitting diode **210** from electrostatic discharge. The antistatic member may absorb electrical shock caused by electrostatic discharge generated near the optical dome **220**.

Referring to FIG. **8**, the light source module **110** may include the non-conductive insulation layer **251**, the conductive conduction layer **252** laminated on the front surface **251***a* of the insulation layer **251** and including the feeding line **230**, and the non-conductive protection layer **253** laminated on the front surface **252***a* of the conduction layer **252**. The insulation layer **251** may be referred to as a first layer, the conduction layer **252** may be referred to as a second layer, and the protection layer **253** may be referred to as a third layer.

The light emitting diode **210** may be disposed on the protection layer **253**. Particularly, the light emitting diode **210** may be disposed on the front surface of the substrate **112** to cover the window formed on the protection layer **253**.

The pair of feeding pads **240** may be formed on the conduction layer **252** and connected to the feeding line **230**. The pair of feeding pads **240** may be electrically connected to the light emitting diode **210** through the window formed in the protection layer **253**. The pair of feeding pads **240** may be arranged separately from each other.

The light source module **110** may include a reflection auxiliary layer **260**.

In an embodiment, the reflection auxiliary layer **260** along with the protection layer **253** may be formed between the pair of feeding pads **240**, thereby reducing a defect rate due to the asymmetry in the size of the pair of feeding pads **240**.

The light emitting diode **210** may include a Distributed Bragg Reflector (DBR) layer **211**.

The DBR layer **211** is a multilayer reflector composed of two materials with different refractive indices. Due to the difference in refractive index of each material, Fresnel reflection occurs at an interface of each DBR layer **211**. Accordingly, the light incident on the DBR layer may be reflected at a wide range of angles, and thus a beam angle of the light emitting diode **210** may be set to approximately 165 degrees or more.

Light emitted from the light emitting diode **210** may be reflected by the DBR layer **211** and re-reflected by the reflection auxiliary layer **260**. Accordingly, it is possible to prevent loss of light traveling into a space between the pair of feeding pads **240**.

Particularly, because the reflection auxiliary layer **260** is formed of a material with a higher reflectivity than the insulation layer **251**, the reflection auxiliary layer **260** may cover the front of the insulation layer **251** so as to prevent a case in which light traveling to the rear of the light emitting diode **210** is absorbed by the insulation layer **251** and the loss of the light occurs.

FIG. **9** is a view illustrating a plurality of light sources divided into a plurality of dimming blocks in the display apparatus according to an embodiment. FIG. **10** is a control block diagram of the display apparatus according to an embodiment.

In order to improve the power consumption while increasing the contrast ratio, the display apparatus **10** may perform

local dimming to vary the brightness of light for each region of the light source device **100** in conjunction with the output image.

For example, the display apparatus **10** may reduce the brightness of the light of the light source **111** of the light source device **100** corresponding to a dark part of the image, so as to make the dark part of the image darker, and the display apparatus **10** may increase the brightness of the light of the light source **111** of the light source device **100** corresponding to a bright part of the image, so as to make the bright part of the image brighter. Accordingly, the contrast ratio of the image may be improved.

The display apparatus **10** may divide the light source device **100** into a plurality of blocks and independently adjusts the current for each block according to the input image. Image transmission from the display apparatus **10** may be performed through local dimming driving for each frame, and the driving of the current may be adjusted according to the number of blocks of the light source **111** divided within the light source device **100**.

As a result, the display apparatus **10** may effectively improve the contrast ratio by reducing the supply current to the dimming block corresponding to the dark area of the input image and by increasing the supply current to the dimming block corresponding to the bright area of the input image.

For the local dimming, the plurality of light sources **111** included in the light source device **100** may be divided into a plurality of dimming blocks **200**. For example, as shown in FIG. **9**, the plurality of dimming blocks **200** may be composed of 5 rows and 12 columns, and thus a total of 60 dimming blocks may be provided. However, the number of dimming blocks **200** is not limited thereto.

Referring to FIG. **9**, each of the plurality of dimming blocks **200** may include at least one light source **111**. The light source device **100** may supply the same driving current to the light sources **111** belonging to the same dimming block **200**, and the light sources **111** belonging to the same dimming block **200** may emit light of the same brightness.

In addition, the light source device **100** may supply different driving current to the light sources **111** belonging to different dimming blocks **200** according to dimming data, and thus the light sources **111** belonging to different dimming blocks **200** may emit light of different brightness.

The plurality of dimming blocks **200** may include N*M light sources arranged in an N*M matrix (N, M are natural numbers). An N*M matrix means a matrix with N rows and M columns.

Because each light source **111** includes a light emitting diode, each of the plurality of dimming blocks **200** may include N*M light emitting diodes.

The plurality of dimming blocks **200** may be disposed on the substrate **112**. That is, N*M light emitting diodes may be disposed on the substrate **112**.

Referring to FIG. **10**, the display apparatus **10** may include a content receiver **80**, an image processor **90**, the panel driver **30**, the display panel **20**, a dimming driver **170**, and the light source device **100**.

The content receiver **80** may include a receiving terminal **81** and a tuner **82** that receive content including video signals and/or audio signals from content sources.

The receiving terminal **81** may receive video signals and audio signals from content sources through a cable.

The tuner **82** may receive a broadcast signal from a broadcast reception antenna or a wired cable. Further, the tuner **82** may extract a broadcast signal of a channel selected by a user from broadcast signals.

The content receiver **80** may receive video signals and audio signals from content sources through the receiving terminal **81** and/or the tuner **82**. The content receiver **80** may output video signals and/or audio signals, which are received through the receiving terminal **81** and/or the tuner **82**, to the image processor **90**.

The image processor **90** may include a processor **91** configured to process image data, and a memory **92** configured to memorize/store programs and data for processing image data.

The memory **92** may store programs and data for processing video signals and/or audio signals. Further, the memory **92** may temporarily store data that is generated in processing video signals and/or audio signals.

The processor **91** may receive video signals and/or audio signals from the content receiver **80**. The processor **91** may decode the video signal into image data. The processor **91** may generate dimming data from the image data. Further, the processor **91** may output image data and dimming data to the panel driver **30** and the dimming driver **170**, respectively.

The image processor **90** may generate image data and dimming data from the video signal obtained by the content receiver **80**. Further, the image processor **90** may transmit image data and dimming data to the display panel **20** and the light source device **100**, respectively.

Image data may include information about the intensity of light transmitted by each of the plurality of pixels (or a plurality of sub-pixels) included in the display panel **20**. The image data may be provided to the display panel **20** through the panel driver **30**.

The panel driver **30** may receive image data from the image processor **90**. The panel driver **30** may drive the display panel **20** according to the image data. In other words, the panel driver **30** may convert image data, which is a digital signal (hereinafter referred to as 'digital image data'), into an analog image signal, which is an analog voltage signal. The panel driver **30** may provide the analog image signal to the display panel **20**. The optical properties (e.g., light transmittance) of the plurality of pixels included in the display panel **20** may change according to the analog image signal.

The panel driver **30** may include a timing controller, a data driver, a scan driver, etc.

The timing controller may receive image data from the image processor **90**. The timing controller may output image data and drive control signals to the data driver and the scan driver. The drive control signal may include a scan control signal and a data control signal. The scan control signal and the data control signal may be used to control the operation of the scan driver and the data driver, respectively.

The scan driver may receive a scan control signal from the timing controller. The scan driver may activate the input of any one row among the plurality of rows in the display panel **20** according to the scan control signal. In other words, the scan driver may convert pixels, which is included in one row among a plurality of pixels arranged in a plurality of rows and a plurality of columns, into a state capable of receiving an analog image signal. At this time, pixels other than pixels in which the input is activated by the scan driver may not receive the analog image signal.

The data driver may receive image data and data control signals from the timing controller. The data driver may output image data to the display panel **20** according to the data control signal. For example, the data driver may receive digital image data from the timing controller. The data driver may convert digital image data into analog image signals.

Further, the data driver may provide an analog image signal to pixels included in any one input-activated row by the scan driver. At this time, pixels in which the input is activated by the scan driver may receive analog image signals. The optical properties (e.g., light transmittance) of input-activated pixels change according to the received analog image signal.

The panel driver **30** may drive the display panel **20** according to image data. Accordingly, an image corresponding to the image data may be displayed on the display panel **20**.

Further, the dimming data may include information about the intensity of light emitted by each of the plurality of light sources (or plurality of dimming blocks) included in the light source device **100**. The dimming data may be provided to the light source device **100** through the dimming driver **170**.

The light source device **100** may include the plurality of light sources **111** configured to emit light. The plurality of light sources **111** is arranged in a matrix form. In other words, the plurality of light sources **111** may be arranged in a plurality of rows and columns.

The light source device **100** may be divided into the plurality of dimming blocks **200**. Further, each of the plurality of dimming blocks **200** may include at least one light source.

The light source device **100** may output surface light by diffusing light emitted from the plurality of light sources **111**. The display panel **20** may include the plurality of pixels, and the display panel **20** may control each of the plurality of pixels to transmit light or block light. An image may be formed by light passing through each of the plurality of pixels.

The light source device **100** may turn off the plurality of light sources corresponding to the dark part of the image, so as to make the dark part of the image darker. Accordingly, as the dark part of the image becomes darker, the contrast ratio of the image may be improved.

Hereinafter an operation, in which the light source device **100** controls the plurality of light sources to emit light in an area corresponding to the bright part of the image and controls the plurality of light sources to not emit light in an area corresponding to the dark part of the image, will be referred to as "local dimming."

For the local dimming, the plurality of light sources **111** included in the light source device **100** may be divided into the plurality of dimming blocks **200** as shown in FIG. **9**. In FIG. **9**, a total of 60 dimming blocks in 5 rows and 12 columns are shown, but the number and arrangement of dimming blocks are not limited to those shown in FIG. **9**.

Each of the plurality of dimming blocks **200** may include at least one light source **111**. The light source device **100** may supply the same driving current to light sources belonging to the same dimming block, and the light sources belonging to the same dimming block may emit light of the same brightness. For example, light sources belonging to the same dimming block may be connected to each other in series, and thus the same driving current may be supplied to the light sources belonging to the same dimming block.

Further, the light source device **100** may further include a plurality of driving elements **300** configured to control driving current supplied to light sources included in each of the plurality of dimming blocks **200**. The driving elements **300** may each be provided to correspond to at least one dimming block **200**. In other words, the driving elements **300** may each drive the dimming block **200**.

Because the light sources included in the dimming block are connected to each other in series, the light sources included in the dimming block may operate as one unit and may form a light source block as one unit.

Therefore, hereinafter, "supplying driving current to the dimming block" may be interpreted as having the same meaning as "supplying driving current to the light sources included in the dimming block."

FIG. **9** illustrates dimming blocks each including nine light sources, but the number and arrangement of light sources included in each dimming block are not limited to those shown in FIG. **9**.

As mentioned above, the image processor **90** may provide dimming data for the local dimming to the light source device **100**. The dimming data may include information about the luminance of each of the plurality of dimming blocks **200**. For example, the dimming data may include information about the intensity of light output from light sources included in each of the plurality of dimming blocks **200**.

The image processor **90** may obtain dimming data from image data.

The image processor **90** may convert image data into dimming data in various ways. For example, the image processor **90** may divide the image I based on image data into a plurality of image blocks. The number of the plurality of image blocks may be equal to the number of the plurality of dimming blocks **200**, and each of the plurality of image blocks may correspond to the plurality of dimming blocks **200**.

The image processor **90** may obtain a luminance value of the plurality of dimming blocks **200** from the image data of the plurality of image blocks. Further, the image processor **90** may generate dimming data by combining the luminance values of the plurality of dimming blocks **200**.

For example, the image processor **90** may obtain a luminance value of each of the plurality of dimming blocks **200** based on a maximum value among luminance values of pixels included in each image block.

A single image block may include a plurality of pixels, and image data of the single image block may include image data of a plurality of pixels (e.g., red data, green data, blue data, etc.). The image processor **90** may calculate the luminance value of each pixel based on the image data of each pixel.

The image processor **90** may set a maximum value among the luminance values of each pixel included in the image block as a luminance value of the dimming block corresponding to the image block. For example, the image processor **90** may set a maximum value among luminance values of pixels included in a i^{th} image block as a luminance value of a i^{th} dimming block, and set a maximum value among luminance values of pixels included in a j^{th} image block as a luminance value of a j^{th} dimming block.

The image processor **90** may generate dimming data by combining the luminance values of the plurality of dimming blocks **200**.

The dimming driver **170** may receive dimming data from the image processor **90**. The dimming driver **170** may drive the light source device **100** according to the dimming data. The dimming data may include information about the luminance of each of the plurality of dimming blocks **200** or information about the brightness of light sources included in each of the plurality of dimming blocks **200**.

The dimming driver **170** may convert dimming data, which is a digital voltage signal, into analog driving current.

The dimming driver **170** may sequentially provide an analog dimming signal to the driving elements **300** corresponding to each of the dimming blocks **200** in an active matrix method.

The dimming driver **170** may include a connector. The dimming driver **170** may transmit a scan signal, a data signal, and a power signal to the driving element **300** through the connector.

The plurality of dimming blocks **200** may be divided into a plurality of groups. Driving current may be supplied simultaneously to dimming blocks belonging to the same group, and driving current may be supplied sequentially at different times to dimming blocks belonging to different groups. The dimming driver **170** may activate dimming blocks belonging to one of the plurality of groups and provide an analog dimming signal to the activated dimming blocks. Thereafter, the dimming driver **170** may activate dimming blocks belonging to different groups and provide an analog dimming signal to the activated dimming blocks.

For example, dimming blocks located in the same row may belong to the same group, and dimming blocks located in different rows may belong to different groups, but the group classification method is not limited thereto. The dimming driver **170** may activate dimming blocks belonging to one group and provide an analog dimming signal to the activated dimming blocks. Thereafter, the dimming driver **170** may activate the input of dimming blocks belonging to another row and provide an analog dimming signal to the dimming blocks in which the input is activated.

A drive circuit of each of the dimming blocks **200** may provide analog driving current corresponding to an analog dimming signal to the light source module **110**. The light sources **111** included in the light source module **110** may emit light by the analog driving current. According to dimming data, light sources belonging to the same dimming block may emit light of the same intensity. Further, according to dimming data, light sources belonging to different dimming blocks may emit light of different intensities.

FIG. **11** illustrates an example of a connection structure of a dimming driver, a driving element, and a dimming block, and line arrangement in the light source device in the display apparatus according to an embodiment.

Referring to FIG. **11**, each of the plurality of dimming blocks may include the plurality of light sources (light emitting diodes) **111** connected in series. For example, the light emitting diode **111** included in one dimming block **200** may be connected to the driving element **300** for light emission.

Hereinafter for convenience of description, a light source connected to a power line **410** in each of the plurality of dimming blocks **200** is defined as 'start light source', and a light source connected to the driving element **300** is defined as 'last light source'.

Among the plurality of light sources **111** connected in series and belonging to one dimming block **200**, a light source **111**, which is the first in the series connection, may be connected to the power line **410** and receive power (driving voltage; VLED), and a light source **111**, which is the last in the series connection, may be connected to the driving element **300**.

While being input-activated by the dimming driver **170**, the driving element **300** may receive an analog dimming signal from the dimming driver **170** and store the received analog dimming signal. Further, while being input-inactivated, the plurality of driving elements **300** may supply driving current corresponding to the stored analog dimming signal to the plurality of light sources (light emitting diodes **111**).

The driving element **300** may control the driving current supplied to each of the plurality of dimming blocks **200** while the driving voltage VLED is applied to the plurality of dimming blocks **200**.

For this, the display apparatus **10** may include a plurality of scan lines S for providing scan signals to the plurality of driving elements **300** and a plurality of data lines D**1** and D**2** for providing analog dimming signals to the plurality of driving elements **300**.

Further, the display apparatus **10** may include the power line **410** for providing driving voltage to the plurality of driving elements **300**.

The plurality of scan lines S, the plurality of data lines D**1** and D**2**, and the power line **410** may be formed on the substrate **112**.

The power line **410**, the scan line S, and the data lines D**1** and D**2** may be formed on the substrate **112**. For example, the power line **410**, the scan line S, and the data lines D**1** and D**2** may all be formed on a second surface **112***b* of the substrate **112**.

The plurality of driving elements **300** may include circuits of various topologies to implement the active matrix driving.

For example, each of the plurality of driving elements **300** may include a circuit of a 1C2T (one capacitor two transistor) topology. However, the circuit structure of the driving element **300** is not limited thereto. For example, the driving element **300** may include a 3TIC topology circuit in which a transistor is added to correct the body effect of the driving transistor.

The driving element **300** may be provided as a single chip with an integrated drive circuit. In other words, the drive circuit may be integrated into one semiconductor chip.

The dimming driver **170** may transmit dimming data corresponding to the input image to the plurality of driving elements **300** through the data lines D**1** and D**2**.

Further, the dimming driver **170** may transmit a timing signal corresponding to a light emission timing of the plurality of dimming blocks **200** to the plurality of driving elements **300** through the scan line S.

The plurality of driving elements **300** may control the driving current supplied to each of the plurality of dimming blocks **200** based on dimming data and timing signals.

FIG. **11** illustrates some of the plurality of dimming blocks **200**. As for the display apparatus **10** according to an embodiment, more dimming blocks **200**, more driving elements **300**, more data lines D**1** and D**2**, and more scan lines S and more power lines **410** connecting the dimming blocks **200** and the driving elements **300** are required for the local dimming.

Therefore, it is required to simplify the arrangement of the data lines D**1** and D**2**, the scan lines S, and the power line **410** on the substrate **112**.

According to an embodiment, the line may include a line (hereinafter referred to as a "control line") connecting the data lines D**1** and D**2**, the scan lines S, the power line **410**, the plurality of driving elements **300**, and the plurality of dimming blocks **200**, and a line (hereinafter referred to as a "block line") connecting the plurality of light sources. However, the type of line is not limited thereto. For example, the line may include a line (hereinafter referred to as "timing line **420**") connecting the plurality of driving elements **300**.

The plurality of dimming blocks **200** may be arranged in a matrix form on the front surface of the substrate **112** of the light source device **100**, and each of the plurality of dimming

blocks **200** may include the plurality of light sources **111**. The plurality of light sources **111** may be turned on by receiving all data signals, scan signals, and power signals.

The plurality of light sources **111** belonging to one dimming block **200** may be arranged in a matrix form on the front surface of the substrate **112**.

According to an embodiment, the plurality of dimming blocks **200** included in two adjacent rows among the plurality of dimming blocks **200** may be electrically connected to the power line **410** extending between the two rows.

According to an embodiment, the power line may be efficiently arranged by arranging only one power line **410** between two rows.

In an embodiment, the plurality of driving elements **300** may be alternately arranged between adjacent columns in a matrix formed by the plurality of dimming blocks **200**.

According to an embodiment, a length of the control line of the plurality of driving elements **300** may be reduced. In addition, according to an embodiment, because the control line of the plurality of driving elements **300** is alternately arranged between the columns of the plurality of dimming blocks **200**, it is possible to secure a wiring passage between the columns of the plurality of dimming blocks **200**.

According to an embodiment, a timing line **420** connecting the plurality of driving elements **300** arranged between the first and second columns and the plurality of driving elements **300** arranged in the third and fourth columns may be formed.

In an embodiment, the driving elements **300** disposed in different columns among the plurality of driving elements **300** may be electrically connected to each other through the timing line **420**.

According to an embodiment, because each of the driving elements **300** is connected in series with the adjacent driving element **300** through the timing line **420**, timing signals may be shared with each other and thus it is possible to reduce the number of data lines D**1** and D**2** and/or scan lines S.

FIG. **11** illustrates the line arrangement of the light source device **100** in which all of the above-described embodiments are combined. However, the light source device **100** according to an embodiment may include line arrangement implemented by each of the above-described embodiments, a combination of some of the above-described embodiments, or a combination of all of the above-described embodiments.

FIG. **12** illustrates an example of line arrangement on the substrate of the display apparatus according to an embodiment. FIG. **12** is a top view of the first side of the substrate **112**. In other words, FIG. **12** illustrates components electrically connected to the first side of substrate **112**. The first side of the substrate **112** may be a side facing the display panel **20** and the optical members **130** and **140**.

Referring to FIG. **12**, the display apparatus includes the driving element **300** and the line **400**.

The driving element **300** may be provided in plurality. The driving element **300** may include a first driving element **310** and a second driving element **320**.

The line **400** may be connected to the dimming driver **170**, the first and second driving elements **310** and **320**, and the light source **111** to transmit signals. The line **400** may transmit power from the dimming driver **170** including the connector to the light source **111** and the driving element **300**.

The dimming driver **170** may be disposed on the light source substrate **112** or on a separate substrate other than the light source substrate **112**.

The line **400** may include the data lines D**1** and D**2**, the scan lines S, the power lines V, the timing lines **420**, and out lines O. The line **400** may include at least a portion of the feeding pad **240**. The line **400** may include various types of lines wired to the light source substrate **112**, as well as the above-mentioned lines.

The data lines D**1** and D**2** may include a first data line D**1** flowing from the dimming driver **170** to the first driving element **310**, and a second data line D**2** flowing from the dimming driver **170** to the second driving element **320**. The first data line D**1** and the second data line D**2** may be provided in plurality.

The scan line S may include a first scan line S**1** flowing from the dimming driver **170** to the first driving element **310**, and a second scan line flowing from the dimming driver **170** to the second driving element **320**. The first scan line S**1** and the second scan line S**2** may be provided in plurality.

The out line O may transmit a data signal from the driving element **300** to the light source **111**. The number of out lines O may vary according to the scan signal and data signal flowing from the dimming driver **170** to the driving element **300**.

The out line O may include a first out line O**1** flowing from the first driving element **310** to the first light source **111**, and a second out line O**2** flowing from the second driving element **320** to the second light source **111**.

The number of data lines D**1** and D**2**, scan lines S, and out lines O is not limited to the above examples.

The line **400** may be disposed on one side of the substrate **112**. For example, the line **400** may not be formed on both surfaces forming the outside of the substrate **112**, but may be formed only on one side forming the outside of the substrate **112**. For example, the line **400** may be provided on the first side of the substrate **112**. The first side may be a side of the substrate **112** facing the display panel.

Because the line **400** is formed only on the first side of the substrate **112**, the lines **400** may intersect each other (region B in FIG. **12**). An intersection area between the lines **400** may be formed in plurality. For example, the data lines D**1** and D**2** for transferring a data signal from the dimming driver **170** to the driving element **300** may intersect the scan line S for transferring a scan signal from the dimming driver **170** to the driving element **300**. The data lines D**1** and D**2** may intersect the power line V configured to supply power (driving voltage: VLED) to the light source **111** and the driving element **300**. The scan line S may intersect the power line V. Further, the out line O may intersect one of the power line V, the scan line S, and the data lines D**1** and D**2**.

For example, the first data line D**1**, the first scan line S**1**, and the power line V flowing to the first driving element **310** may intersect the first out line O**1** flowing from the first driving element **310** to the first light source **111**. Further, the second data line D**2**, the second scan line S, and the power line V flowing to the second driving element **320** may intersect the second out line O**2** flowing from the second driving element **320** to the second light source **111**. In addition, the line **400** connected to the first driving element **310** may intersect the line **400** connected to the second driving element **320**.

When the lines **400** intersect, one of the lines **400** may be disconnected. Therefore, it is required to prevent the lines **400** from being disconnected so as to allow all lines to be electrically connected. Further, the line **400** may pass through the ground (GND) on one side of the substrate **112**, and even in this case, it is required to prevent the disconnection of the line **400**.

According to an embodiment, the display apparatus may include the jumper supporter **500**. For example, the light

source device **100** may include the jumper supporter **500**. The jumper support **500** may be provided in plurality.

By using the jumper supporter **500**, the display apparatus may prevent the disconnection of the line **400** while supporting the optical members **130** and **140**. Because the jumper supporter **500** allows the line **400** provided on one side of the substrate **112** to intersect while supporting the optical members **130** and **140**, it is possible to reduce the number of jumper connectors that is required for the intersection area between the lines **400**. Therefore, by reducing the number of jumper connectors, it is possible to reduce costs and improve process efficiency.

The line **400** may include a first line, a second line, a third line, and a fourth line. In this case, the first line may be the data line D**1** and D**2**, the second line may be the scan line S, the third line may be the power line V, and the fourth line may be the out line O. However, embodiments of the disclosure are not limited to the above example, and the first line may be referred to as a scan line S, a power line V, or an out line O, or may be referred to as another line. Further, the second line may be referred to as a data line D**1** or D**2**, a power line V, or an out line O, or may be referred to as another line. Further, the third line may be referred to as a data line D**1** or D**2**, a scan line S, or an out line O, or may be referred to as another line. Further, the fourth line may be referred to as a data line D**1** or D**2**, a scan line S, or a power line V, or may be referred to as another line.

Various substrate components such as capacitors, resistors, and connectors as well as the line **400**, the light source **111**, and the driving element **300** may be disposed on the substrate **112**. The line **400** may include all lines **400** for electrically connecting the light source **111**, the driving element **300**, the capacitor, the resistor, the connector, etc.

As for the substrate **112** of the display apparatus according to an embodiment, the various components described above may be disposed only on the first side facing the display panel **20** among the outer surfaces **251***b* and **252***a*, and thus it is possible to use the jumper supporter **500** to prevent the disconnection of the lines **400** configured to electrically connect the various components. Accordingly, there is no need to perform the process on both outer surfaces **251***b* and **252***a* of the substrate **112**, and thus the process efficiency may be increased.

FIG. **13** is a view illustrating a jumper supporter being electrically connected to the substrate in the display apparatus according to an embodiment. FIG. **14** is a cross-sectional view of the jumper supporter and the substrate shown in FIG. **13** taken along a direction C-C". The reflective sheet **120** is omitted in FIG. **13**.

Referring to FIGS. **13** and **14**, the display apparatus according to an embodiment includes the substrate **112** and the line **400** provided on the substrate **112**.

The substrate **112** may include the insulation layer **251** and the conduction layer **252**.

The substrate **112** may include a first side facing the display panel **20** and a second side opposite to the first side. The substrate **112** may include the plurality of outer surfaces provided on the outermost side. The outer surface of the substrate **112** may include the first surface **252***a* and the second surface **251***b*. The first surface **252***a* and the second surface **251***b* may be disposed on opposite sides. The first surface **252***a* may be the front surface of the substrate **112**, and the second side **251***b* may be the rear surface of the substrate **112**. The first surface **252***a* may be the front surface of the conduction layer **252**, and the second surface **251***b* may be the rear surface of the insulation layer **251**. The first surface **252***a* may be a side facing the display panel **20**.

The line **400** may be part of conduction layer **252**. The line **400** may be formed only on the first side of substrate **112**. That is, in order to form the line **400**, it is sufficient that the conduction layer **252** is formed on only one surface without being formed on both outer surfaces of the substrate **112**. For example, the line **400** may be formed on the first surface **252***a*.

Because the lines **400** are wired only to the first side of the substrate **112**, the lines **400** may intersect each other. When the lines **400** intersect each other, a single line **400** may be disconnected. The supporter **500** may be used to electrically connect the disconnected line **400**.

The display apparatus according to an embodiment may include the supporter **500**. The supporter **500** may be disposed on the substrate **112** to support the optical members **130** and **140**. For example, the supporter **500** may be disposed on the first side of the substrate **112** facing the display panel **20** and the optical members **130** and **140**.

The supporter **500** may be electrically connected to the substrate **112**. The supporter **500** may allow circuit patterns, which intersect each other, to be connected without being disconnected. For example, the supporter **500** may be disposed in an area where one line **400** and other lines **400** intersect on the first side of the substrate **112**, so as to electrically connect the one line **400** and to guide the other lines **400** to be spaced apart from the one line **400**. The supporter **500** may be referred to as the jumper supporter **500**.

Because the jumper supporter **500** allows the lines **400** provided on one side of the substrate **112** to intersect each other while supporting the optical members **130** and **140**, it is possible to reduce the number of jumper connectors required on an intersection area between the lines **400**. Therefore, by reducing the number of jumper connectors, it is possible to reduce costs and improve process efficiency.

As illustrated in FIG. **13**, when the data line D intersects the scan line S, the power line V, the out line O, and the timing line **420**, the jumper supporter **500** may allow each line to be connected without the disconnection.

However, the case in which the jumper supporter **500** connects the lines **400** is not limited to the above example. For example, when the scan line S intersects the data line D, the power line V, the out line O, and the timing line **420**, the jumper supporter **500** may allow each line to be connected without the disconnection. Alternatively, when the power line V intersects the scan line S, the data line D, the out line O, and the timing line **420**, the jumper supporter **500** may allow each line to be connected without the disconnection. Alternatively, when the out line O intersects the scan line S, the data line D, the power line V, and the timing line **420**, the jumper supporter **500** may allow each line to be connected without the disconnection. Alternatively, when the timing line **420** intersects the scan line S, the data line D, the out line O, and the power line V, the jumper supporter **500** may allow each line to be connected without the disconnection.

Further, even when the scan line S and the power line V extend in a parallel direction, and the out line O and the data line D extend in a direction intersecting the scan line S and the power line V, the jumper supporter **500** may allow each line to be connected without the disconnection.

Further, even when only one line **400** intersects, the jumper supporter **500** may allow each line to be connected without the disconnection.

The line **400** may include the first portion **401** and the second portion **402**, respectively. For example, each of the data line D, the scan line S, the power line V, and the out line line O may be divided into the first portion **401** and the

second portion **402**. The first portion **401** and the second portion **402** may be spaced apart from each other on the conduction layer **252** of the substrate **112**. The jumper supporter **500** may electrically connect the first portion **401** and the second portion **402**. For example, when the data line D is divided into a first portion **401** and a second portion **402**, the jumper supporter **500** may electrically connect the first portion **401** and the second portion **402** and allow one of the scan line S, the power line V, and the out line O to be spaced apart from the data line D.

In the display apparatus according to an embodiment, the jumper supporter **500** may include a base **510** mounted on one surface of the substrate **112**. For example, the base **510** may be disposed on the insulation layer **251** and the conduction layer **252**. Although the base **510** is shown to have a substantially rectangular shape, the shape of the base **510** is not limited to thereto.

The jumper supporter **500** may further include a support portion **520**. The support portion **520** may protrude from the base **510** to support the optical members **130** and **140**. The support portion **520** may be formed to have a smaller cross-sectional area in a direction away from the base **510**. For example, the support portion **520** may have a cone shape. However, the shape of the support portion **520** is not limited to thereto.

The base **510** and the support portion **520** may be formed integrally. When the base **510** and the support portion **520** are formed as one piece, the one piece may be referred to as a body.

The jumper supporter **500** may include a connection portion **530** connected to the conduction layer **252**. The connection portion **530** may be connected to the circuit pattern and/or line **400** provided on the conduction layer **252**. For example, the connection portion **530** may be electrically connected to the lines **400** connected to the driving element **300** and/or the light source **111**.

The connection portion **530** may be formed adjacent to the conduction layer **252** to be soldered to the conduction layer **252**. For example, the connection portion **530** may be formed on the base **510**.

At least one connection portion **530** may be provided. The connection portion **530** may correspond to the number of lines **400** that intersect in the area where the jumper supporter **500** is disposed. For example, when the data line D intersects the scan line S, the power line V, the out line O, and the timing line **420**, the jumper supporter **500** may be connected to the data line D or connected to the scan line S, the power line V, the out line O, and the timing line **420** so as to allow each line to be connected without the disconnection. As shown in FIG. **13**, when the connection portion **530** is connected to the scan line S, the power line V, the out line O, and the timing line **420**, four connection portions **530** may be provided.

The connection portion **530** may be soldered so as to be electrically connected to the conduction layer **252**. For example, a first end of the connection portion **530** is connected to the first portion **401** of the disconnected line **400** through a first soldering portion **601**, and a second end of the connection portion **530** may be connected to the second portion **402** of the disconnected line **400** through a second soldering portion **602**.

The first soldering portion **601** may be provided on the first end side of the connection portion **530**, and the second soldering portion **602** may be provided on the second end side of the connection portion **530**. The first soldering portion **601** may electrically connect the first portion **401** and the connection portion **530**, and the second soldering portion **602** may electrically connect the second portion **402** and the connection portion **530**, thereby electrically connecting the first portion **401** and the second portion **402** which are disconnected.

When the jumper supporter **500** electrically connects the first portion **401** and the second portion **402** of the line **400**, the jumper supporter **500** may be spaced apart from the substrate **112**. For example, as the jumper supporter **500** and the insulation layer **251** are spaced apart from each other, a space **700** may be formed between the jumper supporter **500** and the insulation layer **251**. The space **700** may be an area where the first portion **401** and the second portion **402** of the line **400** are disconnected.

When the lines **400** intersect each other (refer to FIGS. **12** and **13**), one of the lines **400** may be electrically connected by the jumper supporter **500**, and another one **403** of the lines **400** may be disposed in the space **700** formed between the supporter **500** and the insulation layer **251**. Therefore, the one line and the another line **403** of the lines **400** may be wired without interfering with each other.

The jumper supporter **500** may be used in the relationship between the line **400** and the ground GND, as well as between the lines **400**. For example, when the line **400** is wired to the substrate **112**, the line **400** may not bypass the ground GND. At this time, the line **400** may bypass the ground GND through the jumper supporter **500**.

In an embodiment, components including the line **400** and the ground GND may be formed only on the one surface **252***a* of the outer surfaces **252***a* and **251***b* of the substrate **112**. Accordingly, there is no need to wire both outer surfaces **252***a* and **251***b* of the substrate **112**, and the circuit only needs to be wired to the one surface **252***a* of the substrate **112**, thereby improving process efficiency.

FIGS. **15** to **22** illustrate an arrangement relationship between lines in the display apparatus according to an embodiment. FIGS. **15** to **22** are enlarged views schematically illustrating a region "B" shown in FIG. **12**.

Referring to FIG. **12**, in the display apparatus according to an embodiment, the lines **400** are wired only to the first side of the substrate **112**, and thus intersection may be generated between the lines **400**. At this time, the jumper supporter **500** may allow the lines **400** to be connected without the disconnection. The display apparatus may include the jumper supporter **500**. The jumper support **500** may be provided in plurality. The jumper support **500** may be disposed in each a region B, respectively.

Referring to FIG. **15**, the data line D may intersect the scan line S. At this time, as shown in FIG. **14**, the scan line S may be composed of the first portion **401** and the second portion **402**, and the first portion **401** and the second portion **402** may be connected through the jumper supporter **500**. The scan line S may be wired to the jumper supporter **500**. For example, the first portion **401** and the second portion **402** of the scan line S may be connected through the connection portion **530**.

The data line D may be spaced apart from the scan line S. The data line D may pass through the space **700** between the jumper supporter **500** and the insulation layer **251**. For example, because the jumper supporter **500** is disposed on the conduction layer **252**, the space **700** may be formed between the jumper supporter **500** and the insulation layer **251**, and the data line D may be wired to the space **700**.

In this case, a jumper supporter **500** configured to connect the first portion **401** and the second portion **402** of the scan line S and provided to allow the data line D to pass between the insulation layer **251** and the jumper supporter **500** may be referred to as "first jumper supporter **500**".

However, embodiments of the disclosure are not limited thereto. Accordingly, a jumper supporter **500** disposed in an area where the scan line S intersects the power line V, an area where the scan line S intersects the out line O, an area where the data line D intersects the power line V, an area where the data line D intersects the out line O, and/or an area where the power line V intersects the out line O may be referred to as "first jumper supporter **500**".

Referring to FIG. **16**, the power line V may intersect the scan line S. At this time, the scan line S may be composed of the first portion **401** and the second portion **402**, and the first portion **401** and the second portion **402** may be connected through the jumper supporter **500**. The scan line S may be wired to the jumper supporter **500**. For example, the first portion **401** and the second portion **402** of the scan line S may be connected through the connection portion **530**.

As illustrated in FIG. **14**, the power line V may pass through the space **700** between the jumper supporter **500** and the insulation layer **251**. The power line V may be spaced apart from the scan line S.

In this case, a jumper supporter **500** configured to connect the first portion **401** and the second portion **402** of the scan line S and provided to allow the power line V to pass between the insulation layer **251** and the jumper supporter **500** may be referred to as "second jumper supporter **500**".

However, embodiments of the disclosure are not limited thereto. Accordingly, a jumper supporter **500** disposed in an area where the scan line S intersects the data line D, an area where the scan line S intersects the out line O, an area where the data line D intersects the power line V, an area where the data line D intersects the out line O, and/or an area where the power line V intersects the out line O may be referred to as "second jumper supporter **500**".

Referring to FIG. **17**, the power line V may intersect the data line D. At this time, the data line D may be composed of the first portion **401** and the second portion **402**, and the first portion **401** and the second portion **402** may be connected through the jumper supporter **500**. The data line D may be wired to the jumper supporter **500**. For example, the first portion **401** and the second portion **402** of the data line D may be connected through the connection portion **530**.

As illustrated in FIG. **14**, the power line V may pass through the space **700** between the jumper supporter **500** and the insulation layer **251**. The power line V may be spaced apart from the data line D.

In this case, a jumper supporter **500** configured to connect the first portion **401** and the second portion **402** of the data line D and provided to allow the power line V to pass between the insulation layer **251** and the jumper supporter **500** may be referred to as "third jumper supporter **500**".

However, embodiments of the disclosure are not limited thereto. Accordingly, a jumper supporter **500** disposed in an area where the scan line S intersects the data line D, an area where the scan line S intersects the out line O, an area where the scan line S intersects the power line V, an area where the data line D intersects the out line O, and/or an area where the power line V intersects the out line O may be referred to as "third jumper supporter **500**".

Referring to FIG. **18**, the data line D may intersect the scan line S. At this time, the data line D may be composed of the first portion **401** and the second portion **402**, and the first portion **401** and the second portion **402** may be connected through the jumper supporter **500**. The data line D may be wired to the jumper supporter **500**. For example, the first portion **401** and the second portion **402** of the data line D may be connected through the connection portion **530**.

As illustrated in FIG. **14**, the scan line S may pass through the space **700** between the jumper supporter **500** and the insulation layer **251**. The scan line S may be spaced apart from the data line D.

In this case, a jumper supporter **500**, which is shown in FIG. **18**, configured to connect the first portion **401** and the second portion **402** of the data line D and provided to allow the scan line S to pass between the insulation layer **251** and the jumper supporter **500** may be referred to as "first jumper supporter **500**" like the jumper supporter **500** of FIG. **15**.

Referring to FIG. **19**, the power line V may intersect the scan line S. At this time, the power line V may be composed of the first portion **401** and the second portion **402**, and the first portion **401** and the second portion **402** may be connected through the jumper supporter **500**. The power line V may be wired to the jumper supporter **500**. For example, the first portion **401** and the second portion **402** of the power line V may be connected through the connection portion **530**.

As illustrated in FIG. **14**, the scan line S may pass through the space **700** between the jumper supporter **500** and the insulation layer **251**. The scan line S may be spaced apart from the power line V.

In this case, a jumper supporter **500**, which is shown in FIG. **19**, configured to connect the first portion **401** and the second portion **402** of the power line V and provided to allow the scan line S to pass between the insulation layer **251** and the jumper supporter **500** may be referred to as "second jumper supporter **500**" like the jumper supporter **500** of FIG. **16**.

Referring to FIG. **20**, the power line V may intersect the data line D. At this time, the power line V may be composed of the first portion **401** and the second portion **402**, and the first portion **401** and the second portion **402** may be connected through the jumper supporter **500**. The power line V may be wired to the jumper supporter **500**. For example, the first portion **401** and the second portion **402** of the power line V may be connected through the connection portion **530**.

As illustrated in FIG. **14**, the data line D may pass through the space **700** between the jumper supporter **500** and the insulation layer **251**. The data line D may be spaced apart from the power line V.

In this case, a jumper supporter **500**, which is shown in FIG. **20**, configured to connect the first portion **401** and the second portion **402** of the power line V and provided to allow the data line D to pass between the insulation layer **251** and the jumper supporter **500** may be referred to as "third jumper supporter **500**" like the jumper supporter **500** of FIG. **17**.

Referring to FIG. **21**, the out line O may intersect one of the data line D, the scan line S, and the power line V. One of the data line D, the scan line S, and the power line V may be composed of the first portion **401** and the second portion **402**, and the first portion **401** and the second portion **402** may be connected through the jumper supporter **500**. One of the data line D, the scan line S, and the power line V may be wired to the jumper supporter **500**. For example, the first portion **401** and the second portion **402** of one of the data line D, the scan line S, and the power line V may be connected through the connection portion **530**.

As illustrated in FIG. **14**, the out line O may pass through the space **700** between the jumper supporter **500** and the insulation layer **251**. The out line O may be spaced apart from one of the data line D, the scan line S, and the power line V.

In this case, a jumper supporter **500** configured to connect the first portion **401** and the second portion **402** of one of the data line D, the scan line S, and the power line V and provided to allow the data line D to pass between the insulation layer **251** and the jumper supporter **500** may be referred to as "fourth jumper supporter **500**".

Referring to FIG. **22**, one of the data line D, the scan line S, and the power line V may intersect the out line O. The out line O may be composed of the first portion **401** and the second portion **402**, and the first portion **401** and the second portion **402** may be connected through the jumper supporter **500**. The out line O may be wired to the jumper supporter **500**. For example, the first portion **401** and the second portion **402** of the out line O may be connected through the connection portion **530**.

As illustrated in FIG. **14**, one of the data line D, the scan line S, and the power line V may pass through the space **700** between the jumper supporter **500** and the insulation layer **251**. One of the data line D, the scan line S, and the power line V may be spaced apart from the out line O.

In this case, a jumper supporter **500**, which is shown in FIG. **22**, configured to connect the first portion **401** and the second portion **402** of the out line O and provided to allow one of the data line D, the scan line S, and the power line V to pass between the insulation layer **251** and the jumper supporter **500** may be referred to as "fourth jumper supporter **500**" like the jumper supporter **500** of FIG. **21**.

The timing line **420** may intersect one of the out line O, the power line V, the scan line S, and the data line D. However, the jumper supporter **500** may be used in the case in which the timing line **420** intersects one of the out line O, the power line V, the scan line S, and the data line D.

In addition, a jumper supporter **500** may be disposed in an area where a plurality of parallel lines **400** intersects a plurality of lines **400** that intersects the plurality of parallel lines **400**, so as to allow the lines **400** to be connected without the disconnection between the lines **400**.

The display apparatus according to an embodiment may include the display panel **20** and the light source device **100** configured to provide light to the display panel.

In the display apparatus according to an embodiment, the light source device **100** may include the optical members **130** and **140**, the substrate **112** including the first side facing the display panel and the optical members, the light source **111** disposed on the first side of the substrate, the driving element **300** disposed on the first side of the substrate to drive the light source, the line **400** disposed on the first side of the substrate and including the first line **410**, **420**, S. D. and O and the second line **410**, **420**. S. D, and O connected to the driving element, and the jumper supporter **500** disposed on the first side of the substrate and configured to support the optical members **130** and **140**.

In the display apparatus according to an embodiment, the jumper supporter **500** may be disposed on an area where the first line **410**, **420**. S, D or O intersects the second line **410**, **420**, S, D, or O to electrically connect the first line **410**, **420**, S, D or O and to guide the second line **410**, **420**, S, D, or O to be spaced apart from the first line **410**, **420**, S, D, or O.

In the display apparatus according to an embodiment, the substrate **112** may include the insulation layer **251** including the first side facing the optical members, and the conduction layer **252** laminated on the first side of the insulation layer and including the first side facing the optical members.

In the display apparatus according to an embodiment, the jumper supporter **500** may be soldered to the conduction layer **252** on the first side of the conduction layer **252** to electrically connect the first line.

In the display apparatus according to an embodiment, the jumper supporter **500** may include the base **510** disposed on the conduction layer, the support portion **520** protruded from the base to support the optical members, and the connection portion **530** formed on the base to electrically connect the first line.

In the display apparatus according to an embodiment, the first line **410**, **420**, S. D, and O may include the first portion **401** and the second portion **402** disconnected from the first portion. The connection portion **530** of the jumper supporter may connect the first portion **401** and the second portion **402**.

In the display apparatus according to an embodiment, the second line **410**, **420**. S, D, and O may be disposed between the insulation layer **251** and the base **510** of the jumper supporter.

In the display apparatus according to an embodiment, the line may include the scan line S configured to provide a scan signal to the driving element, the data line D configured to provide a data signal to the driving element, the power line V and **410** configured to provide a power signal to the light source, and the out line O configured to provide a signal from the driving element to the light source.

In the display apparatus according to an embodiment, the jumper supporter **500** may be the first jumper supporter **500** disposed in an area where the scan line S intersects the data line D.

In the display apparatus according to an embodiment, the scan line S may be the first line electrically connected by the first jumper supporter **500**, and the data line D may be the second line spaced apart from the first line by the first jumper supporter **500**.

In the display apparatus according to an embodiment, the light source device may include the second jumper supporter **500** disposed in an area where the power line V or **410** intersects the scan line S.

In the display apparatus according to an embodiment, the scan line S may be the first line electrically connected by the second jumper supporter **500** and the power line V or **410** may be the second line spaced apart from the first line by the second jumper supporter **500**.

In the display apparatus according to an embodiment, the light source device **100** may include the third jumper supporter disposed in an area where the power line V or **410** intersects the data line D.

In the display apparatus according to an embodiment, the data line D may be the first line electrically connected by the third jumper supporter **500**, and the power line V or **410** may be the second line spaced apart from the first line by the third jumper supporter **500**.

In the display apparatus according to an embodiment, the light source device **100** may further include the fourth jumper supporter **500** disposed in an area where the out line O) intersects at least one of the data line D, the scan line S and the power line V or **410**.

In the display apparatus according to an embodiment, the out line O may be the first line electrically connected by the fourth jumper supporter **500** and the one of the data line D, the scan line S and the power line V or **410** may be a second line spaced apart from the first line by the fourth jumper supporter **500**.

The display apparatus according to an embodiment may further include the dimming driver **170** configured to transmit the scan signal, the data signal, and the power signal to the driving element.

The display apparatus according to an embodiment may include the display panel **20** and the light source device **100** configured to provide light to the display panel.

In the display apparatus according to an embodiment, the light source device **100** may include the light source Ill facing the display panel, the driving element **300** configured to supply a driving signal to the light source, the substrate **112** including the insulation layer **251** and the conduction layer **252** laminated on the insulation layer and soldered to the light source and the driving element, the line **400** disposed on the conduction layer and including the first line **410**, **420**, S, D, and O and the second line **410**, **420**, S, D, and O connected to the driving element, the optical members **130** and **140** disposed between the display panel and the substrate, and the jumper supporter **500** provided to support the optical members and disposed on an area where the first line **410**, **420**, S, D or O intersects the second line **410**, **420**, S, D, or O.

In the display apparatus according to an embodiment, the jumper supporter **500** may be configured to electrically connect the first line, and the second line may be spaced apart from the insulation layer **251** to be disposed between the jumper supporter **500** and the insulation layer **251**.

In the display apparatus according to an embodiment, the driving element **300** may include the first driving element **310** and the second driving element **320** configured to receive the scan signal, the data signal, and the power signal, respectively, from the dimming driver.

In the display apparatus according to an embodiment, the jumper supporter **500** may be disposed in an area where at least one of the scan line S**1** and the data line D**1** connected to the first driving element **310** intersects at least one of the scan line S**2** and the data line D**2** connected to the second driving element **320**.

In the display apparatus according to an embodiment, the first line may be disconnected and divided into the first portion **401** and the second portion **402**. The first portion and the second portion may be electrically connected through the jumper supporter **500**.

In the display apparatus according to an embodiment, the jumper supporter **500** may include the base **510** disposed on the conduction layer, the support portion **520** protruding from the base to support the optical members, and the connection portion **530** formed on the base to electrically connect the first line.

In the display apparatus according to an embodiment, the second line may be disposed between the insulation layer **251** and the base **510** of the jumper supporter **500**.

The display apparatus according to an embodiment may include the display panel **20** and the light source device **100** configured to provide light to the display panel.

In the display apparatus according to an embodiment, the light source device **100** may include the optical members **130** and **140**, the substrate **112** including the first side facing the display panel and the optical members, the light source **111** disposed on the first side, the driving element **300** disposed on the first side to provide a driving signal to the light source, the line **400** disposed on the first side and including the scan line S configured to provide a scan signal to the driving element, the data line D configured to provide a data signal to the driving element, the power line V or **410** configured to provide a power signal to the light source, and the out line O configured to provide a signal from the driving element to the light source, and the jumper supporter **500** provided to support the optical members **130** and **140** and disposed on an area where one of the lines **400** intersects another one of the lines **400** on the first side.

In the display apparatus according to an embodiment, the jumper supporter **500** may be configured to electrically connect the one of the lines **400** and configured to guide the another one of the lines **400** to be spaced apart from the one of the lines.

The jumper supporter **500** may allow the intersection between the lines **400** arranged on one surface of the substrate **112** while supporting the optical members **130** and **140**. Therefore, it is possible to reduce the number of jumper connectors that is required in the intersection area between the lines **400**. Further, it is possible to reduce the costs and improve the process efficiency due to the reduction in the number of jumper connectors.

While the present disclosure has been particularly described with reference to exemplary embodiments, it should be understood by those of skilled in the art that various changes in form and details may be made without departing from the spirit and scope of the present disclosure.

What is claimed is:

1. A display apparatus comprising:

a display panel; and

a light source device configured to provide light to the display panel,

wherein the light source device comprises:

an optical member;

a substrate comprising a first side facing the display panel and the optical member;

a light source provided on the first side of the substrate;

a driving element provided on the first side of the substrate and configured to drive the light source;

a plurality of lines provided on the first side of the substrate, the plurality of lines comprising a first line and a second line that are connected to the driving element; and

a jumper supporter provided on the first side of the substrate in an area where the first line intersects the second line, the jumper supporter being configured to support the optical member, to electrically connect the first line, and to guide the second line to be spaced apart from the first line.

2. The display apparatus of claim **1**, wherein the substrate comprises:

an insulation layer comprising a first side facing the optical member; and

a conduction layer laminated on the first side of the insulation layer and comprising a first side facing the optical member, and

wherein the jumper supporter is soldered to the first side of the conduction layer to electrically connect the first line.

3. The display apparatus of claim **2**, wherein the jumper supporter comprises:

a base provided on the conduction layer;

a support portion protruded from the base and configured to support the optical member; and

a connection portion provided on the base to electrically connect the first line.

4. The display apparatus of claim **3**, wherein the first line comprises:

a first portion; and

a second portion disconnected from the first portion, and

wherein the connection portion of the jumper supporter connects the first portion and the second portion.

5. The display apparatus of claim **4**, wherein the second line is between the insulation layer and the base of the jumper supporter.

6. The display apparatus of claim 1, wherein the plurality of lines further comprises:

a scan line configured to provide a scan signal to the driving element;

a data line configured to provide a data signal to the driving element;

a power line configured to provide a power signal to the light source; and

an out line configured to provide a signal from the driving element to the light source.

7. The display apparatus of claim 6, wherein the jumper supporter is a first jumper supporter provided in an area where the scan line intersects the data line.

8. The display apparatus of claim 7, wherein the first line is the scan line; and

wherein the second line is the data line.

9. The display apparatus of claim 7, wherein the light source device further comprises a second jumper supporter provided in an area where the power line intersects the scan line.

10. The display apparatus of claim 9, wherein the scan line is electrically connected by the second jumper supporter; and

wherein the power line is spaced apart from the scan line by the second jumper supporter.

11. The display apparatus of claim 9, wherein the light source device further comprises a third jumper supporter provided in an area where the power line intersects the data line.

12. The display apparatus of claim 11, wherein the data line is electrically connected by the third jumper supporter; and

wherein the power line is spaced apart from the data line by the third jumper supporter.

13. The display apparatus of claim 11, wherein the light source device further comprises a fourth jumper supporter provided in an area where the out line intersects at least one of the data line, the scan line and the power line.

14. The display apparatus of claim 13, wherein the out line is electrically connected by the fourth jumper supporter; and

wherein at least one of the data line, the scan line and the power line is spaced apart from the out line by the fourth jumper supporter.

15. The display apparatus of claim 6, further comprising:

a dimming driver configured to transmit the scan signal, the data signal, and the power signal to the driving element,

wherein the driving element comprises a first driving element and a second driving element, and the first driving element and the second driving element are respectively configured to receive the scan signal, the data signal, and the power signal from the dimming driver,

wherein the scan line comprises a first scan line connected to the first driving element and a second scan line connected to the second driving element,

wherein the data line comprises a first data line connected to the first driving element and a second data line connected to the second driving element, and

wherein the jumper supporter is provided in an area where at least one of the first scan line and the first data line intersects at least one of the second scan line and the second data line.

16. A light source device comprising:

an optical member;

a substrate comprising a first side facing the optical member;

a light source provided on the first side of the substrate;

a driving element provided on the first side of the substrate and configured to drive the light source;

a plurality of lines provided on the first side of the substrate, wherein the plurality of lines comprises a first line and a second line that are connected to the driving element; and

a jumper supporter provided on the first side of the substrate in an area where the first line intersects the second line, the jumper supporter being configured to support the optical member, to electrically connect the first line, and to guide the second line to be spaced apart from the first line.

17. The light source device of claim 16, wherein the first line comprises a first portion and a second portion,

wherein the substrate comprises:

an insulation layer comprising a first side facing the optical member; and

a conduction layer laminated on the first side of the insulation layer and comprising a first side facing the optical member, and

wherein the jumper supporter is electrically connected to the first side of the conduction layer and electrically connects the first portion of the first line and the second portion of the first line.

18. The light source device of claim 17, wherein the jumper supporter comprises:

a base provided on the conduction layer;

a support portion protruded from the base and configured to support the optical member; and

a connection portion provided on the base, and

wherein the connection portion of the jumper supporter connects the first portion of the first line to the second portion of the first line.

19. The light source device of claim 18, wherein the second line is between the insulation layer and the base of the jumper supporter.

20. The light source device of claim 16, wherein the plurality of lines further comprises a plurality of first lines which includes the first line,

wherein each first line of the plurality of first lines comprises a first portion and a second portion,

wherein the substrate comprises:

an insulation layer comprising a first side facing the optical member; and

a conduction layer laminated on the first side of the insulation layer and comprising a first side facing the optical member,

wherein the jumper supporter comprises:

a base provided on the conduction layer;

a support portion protruded from the base and configured to support the optical member; and

a plurality of connection portions provided on the base,

wherein each connection portion of the plurality of connection portions corresponds to a respective first line of the plurality of first lines, and each connection portion of the plurality of connection portions connects the first portion and the second portion of the respective first line corresponding to the connection portion, and

wherein the jumper supporter is further configured to guide the second line to be spaced apart from each first line of the plurality of first lines.

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